

99TH ANNUAL REPORT OF THE STATE GEOLOGIST

of

INDIANA GEOLOGICAL SURVEY  
DEPARTMENT OF NATURAL RESOURCES

for

July 1, 1974 - June 30, 1975

GEOLOGICAL SURVEY  
NINETY-NINTH 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

Charles E. Wier . . . . . Geologist and Head  
(On leave since July 1, 1974)  
(Resigned May 13, 1975)  
Richard L. Powell . . . . . Geologist and Acting Head  
(July 1, 1974 to June 30, 1975)  
Donald Eggert . . . . . Geologist  
Harold C. Hutchison . . . . . Geologist  
Marvin T. Iverson . . . . . Geological Assistant  
Bonnie Burks . . . . . Secretary

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

### Geochemistry Section

Richard K. Leininger . . . . . Geochemist and Head  
Carrie Foley . . . . . Laboratory Technician  
(To May 12, 1975)  
Margaret V. Golde . . . . . Instrumental Analyst  
Louis V. Miller . . . . . Coal Chemist  
Pamela Tracey . . . . . 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  
John R. Helms . . . . . Geophysical Assistant  
Joseph F. Whaley . . . . . Geophysicist  
Cynthia Prall . . . . . Secretary  
(From December 9, 1974)  
Julie A. Royster . . . . . Secretary  
(To December 6, 1974)

### Industrial Minerals Section

Donald D. Carr . . . . . Geologist and Head  
Curtis H. Ault . . . . . Geologist  
George S. Austin . . . . . Geologist  
(To August 14, 1974)  
Michael C. Moore . . . . . Geologist  
Nelson R. Shaffer . . . . . Geologist  
(From December 30, 1974)  
Pamela Tracey . . . . . Secretary

### Petroleum Section

Leroy E. Becker	Geologist
G. L. Carpenter	Geologist
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
Donna C. Schultz	Senior Sales and Records Clerk

### Seasonal Personnel

### Geochemistry Section

Ardith Bennett	Laboratory Assistant (October 20, 1974 to December 14, 1974)
Liesbeth Ellen Cook	Data Checker (October 6, 1974 to November 16, 1974)
Holly C. Deiss	Laboratory Assistant (October 6, 1974 to December 28, 1974)
James E. Golden Jr.	Sample Preparer (October 6, 1974 to May 3, 1975)
Elizabeth Inouye	Laboratory Assistant (May 4, 1975 to June 14, 1975)
John Letts	Laboratory Assistant (October 6, 1974 to May 3, 1975)
Sheila Mulhall	Laboratory Assistant (May 18, 1975 to June 30, 1975)
Kenneth Rudy	Sample Preparer (October 6, 1974 to June 30, 1975)
R. Gerald Searles	Sample Preparer (October 6, 1974 to December 14, 1974)
Dean Wade	Laboratory Assistant (September 22, 1974 to May 3, 1975)

## Geology Section

Paula Barbour	Laboratory Assistant (July 1, 1974 to December 28, 1974)
Alan Barker	Laboratory Assistant (July 1, 1974 to March 8, 1975)
Mary Barker	Laboratory Assistant (July 1, 1974 to March 22, 1975)
John Bassett	Geologist (February 9, 1975 to June 30, 1975)
Robert Bonebrake	Laboratory Assistant (January 12, 1975 to April 19, 1975)
Donald Brawley	Laboratory Assistant (July 1, 1974 to November 16, 1974)
Alice Evans	Laboratory Assistant (June 1, 1975 to June 14, 1975)
Todd Frazier	Laboratory Assistant (May 18, 1975 to June 14, 1975)
Samuel Frushour	Laboratory Assistant (December 29, 1974 to June 30, 1975)
Alfredo Gracia	Laboratory Assistant (October 6, 1974 to December 14, 1974)
Lauren Hughes	Laboratory Assistant (September 8, 1974 to November 2, 1974)
David Kazmirski	Laboratory Assistant (August 25, 1974 to June 30, 1975)
Kerry Maddox	Laboratory Assistant (July 1, 1974 to November 2, 1974)
Paul Nicholls	Laboratory Assistant (September 8, 1974 to October 5, 1974)
James Pond	Laboratory Assistant (October 20, 1974 to April 19, 1975)
John Railing	Laboratory Assistant (November 3, 1974 to December 28, 1974)
William Slingerland	Laboratory Assistant (August 25, 1974 to September 7, 1974)
Greg Spaulding	Laboratory Assistant (August 25, 1974 to April 19, 1975)
William Wilson	Laboratory Assistant (August 25, 1974 to April 5, 1975)

## Geophysics Section

Nancy Hasenmueller	Geologist (July 1, 1974 to June 30, 1975)
Rebecca Jane Hoadley	Clerk Typist (July 1, 1974 to May 3, 1975)
Albert J. Rudman	Geophysicist (May 5, 1975 to June 30, 1975)
Madan Varma	Geophysicist (July 1, 1974 to August 24, 1974)
Tom Zeller	Geophysical Assistant (June 15, 1975 to June 30, 1975)

### Industrial Minerals Section

Susan Fischer	Laboratory Assistant (September 8, 1974 to December 14, 1974)
William Glover	Laboratory Assistant (April 6, 1975 to May 3, 1975)
Constance Pacay	Laboratory Assistant (July 1, 1974 to December 14, 1974)
Steven Lutter	Laboratory Assistant (July 1, 1974 to August 16, 1974)
Clyde Cody	Field Assistant (June 16, 1975 to June 30, 1975)

### Petroleum Section

Frank Cioffi	Geological Assistant (July 1, 1974 to June 30, 1975)
Paul Dubois	Geological Assistant (July 1, 1974 to June 30, 1975)
Larry Enochs	Geological Assistant (July 1, 1974 to August 26, 1974) (June 3, 1975 to June 30, 1975)
Jane Jackson	Laboratory Assistant (May 19, 1975 to June 30, 1975)
Lawrence Kong	Laboratory Assistant (May 19, 1975 to June 30, 1975)
Eric D. Martz	Laboratory Assistant (January 6, 1975 to May 17, 1975)
Joseph W. Oliver	Laboratory Assistant (May 12, 1975 to June 30, 1975)

### Publications Section

Marsha L. Rohleder	Clerk (June 9, 1975 to June 30, 1975)
Sharon Anne Russell	Clerk (July 1, 1974 to June 20, 1975)

STATISTICAL SUMMARY OF ACTIVITIES FOR FISCAL 1974-75

Many of the activities of the Geological Survey can be most readily summarized by the statistical listing that follows:

Projects in Progress . . . . .	35
Projects completed . . . . .	13
Special Field Trips Conferences. . . . .	63
Conferences with visitors to the Survey. . . . .	1,025
Visitor days. . . . .	498
Man days of field work . . . . .	1,083
Incoming letters . . . . .	5,304
Outgoing letters . . . . .	2,490
Total number of Survey vehicles. . . . .	20
Total number of miles traveled in survey vehicles . . . . .	185,063
Number of stratigraphic section messages. . . . .	49
Thickness of stratigraphic sections measured . . . . .	4,153
Public lectures (total). . . . .	38
Civic . . . . .	5
Industrial. . . . .	1
School. . . . .	15
Other . . . . .	2
Institutional conferences. . . . .	1
Papers submitted. . . . .	1
Papers presented at professional meetings. . . . .	20
Field trips for the public . . . . .	6
In connection with conferences. . . . .	6
Educational . . . . .	4
Industrial . . . . .	1
News releases submitted. . . . .	13
Illustrated news items distributed to Indiana news papers, radio and television stations . . . . .	875
News letters . . . . .	1
Attendance at professional meetings. . . . .	54
Meetings sponsored by the Geological Survey. . . . .	1
Exhibits prepared for special occasions. . . . .	9
Tours of Geology Building. . . . .	7
Samples received or collected. . . . .	1,143
Rocks, Minerals . . . . .	816
Fossils . . . . .	327
Identifications (Rocks, Minerals, Fossils) . . . . .	291
Packets of geologic education material sent. . . . .	113
Special rock sets for teachers . . . . .	7
Rock and mineral sets sent . . . . .	101

Coal analysis . . . . .	81
Samples . . . . .	1,346
Determinations . . . . .	1,896
Rock analysis (magnetic, mineralogical, textural and physical)	969
Samples . . . . .	2,957
Determinations . . . . .	1,378
Spectrographic analysis (qualitative) . . . . .	2,760
Spectrographic analysis (quantitative) . . . . .	
X-ray analyses . . . . .	122
Samples . . . . .	540
Determinations . . . . .	30
X-ray mineralogic analyses . . . . .	12
Physical tests on building stone . . . . .	4
Physical tests on other stone . . . . .	356
Seismic réfraction shots . . . . .	3,233
Feet of hole drilled . . . . .	1,992
Feet of core recovered . . . . .	106
Number of holes augered . . . . .	2,426
Feet of hole augered . . . . .	3,231
Feet of core described . . . . .	399
Current drilling . . . . .	165
Well cutting sets catalogued and filed . . . . .	7
Well cores catalogued and filed . . . . .	154
Strip logs made (wells) . . . . .	235,664
Feet represented on strip logs . . . . .	98
Environmental impact statements . . . . .	18
Memorandum reports on special projects . . . . .	
Reports completed for official publication (in editorial process) . . . . .	4
Special reports . . . . .	1
Occasional papers . . . . .	5
State park guide . . . . .	1
Published reports . . . . .	11
Bulletins . . . . .	1
Mineral economic series . . . . .	1
Report of progress . . . . .	2
Special reports . . . . .	3
State park guide . . . . .	2
Occasional paper . . . . .	19
Directories . . . . .	2
Published maps . . . . .	2
Miscellaneous (new) . . . . .	4
Miscellaneous (revised) . . . . .	1
County base maps (revised) . . . . .	1



Petroleum exploration maps . . . . .	90
Revised . . . . .	109
Checked without revision. . . . .	6,835
Published reports sold . . . . .	12,333
Published maps sold. . . . .	4,388
Publications office customers. . . . .	1,201
Publications announcements mailed. . . . .	8
Outside publications . . . . .	10
Abstracts . . . . .	9
Reports republished . . . . .	9
Complete reports . . . . .	15
Reports completed and sent to editors for outside publication . . . . .	4
Abstracts . . . . .	8
Complete reports. . . . .	420
Telephone conferences . . . . .	891
Total service requests. . . . .	

## COAL SECTION

Because of the increased emphasis being placed on coal due to the national energy situation, service work requests for information from private individuals, coal companies, consulting firms, governmental agencies, etc. have continued to take a substantially greater amount of time for members of the Coal Section. During the year a total of 389 information requests were handled by the Section. In addition, 143 letters were written in answer to requests. Topics involved in our service work would fall into six broad categories, namely: 1) stratigraphy and general geology associated with the coal measures of Indiana; 2) location, extent, quantity, and quality of coal reserves in both the strippable and underground minable categories; 3) location and extent of previously mined areas of coal; 4) ecological and environmental aspects of coal mining and utilization; 5) general economics of the coal industry; and 6) conversion of coal to gas, liquid hydrocarbons, and other techniques for modifying coal as a source of energy.

### Preliminary coal map of Greene, Owen, and Putnam Counties

No work was accomplished during the year on this project, however most of the data have been collected and the work maps are on file in the Coal Section. With the completion of this map we will have county coverage for each of the coal producing counties in the state. These maps will show the area covered by each of the major coals present, the areas mined by both strip and underground mines, and a structure map on one of these coal beds.

### Distribution of acid-forming material in overburden

In recent years there has been increased emphasis placed on evaluating acid-forming minerals in overburden rocks prior to strip mining. Such a study is concentrated on the pyrite content in the different types of sandstones and shales that overlie coal seams being sought. A study of samples collected from the high walls of active strip mines along with core drill hole samples from locations in advance of the mining operation is being made. Analyses of these samples provide the data necessary for planning the handling of obvious acid-producing materials in a selective manner to be sure that those materials will be placed at depth and covered with materials more suited for plant growth. No work was accomplished on this project during the year, however, a degree of continuance has been provided on this study by incorporating it with the "Cast overburden rock weathering" project. In that project rock size and rates of disintegration of various overburden materials involved with reclamation of strip mined lands is being studied. High wall rock samples from active strip mines and rock samples from drill hole cores in advance of mining are being taken to facilitate formulation of selective mining procedures to bury rocks that are highly resistant to disintegration. As mentioned above, another facet of this project was to incorporate the determination of acid-forming materials in overburden to insure that these types of materials would also be placed at depth in reclaimed areas. This project is 49 percent complete.

### 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 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 a total of 1,763 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.

### Strippable coal resources

This project represents an ongoing and continuing compilation of the strippable coal resources of the state. As new exploration data are obtained, larger and improved designs of mining equipment produced, and a rapidly changing economic profile evolves for the coal industry, new strip minable coal resources become available. All of these factors are taken into consideration and a running account of the strippable coal resources of the state is kept. In addition, current strip mined areas are plotted annually and mined tonnages are subtracted from the strippable reserves.

### Active coal mine map

In March 1975 the "Map of southwestern Indiana showing location of active coal mines" (Misc. Map No. 7) was revised and published. As of April 1, 1975 there were a total of 73 mines or pits active in the state. All but two of these were strip mines.

### Satellite imagery interpretation

A preliminary study of underground mine subsidence was completed from aerial photography. Along with the previous completion of lineament studies from the MSS imagery derived from NASA's ERTS satellite for which the Coal Section was the Principal Investigator, this project was officially completed as of January 1975.

## DRAFTING AND PHOTOGRAPHY

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

Jobs completed for publishing by the Geological Survey include drafting and photography for 6 Bulletins, 1 Special Report, 1 Mineral Economic Series, 9 Occasional Papers, 1 Directory, 2 Miscellaneous Maps, and 1 Base Map.

The series of petroleum exploration maps of Indiana counties and Miscellaneous Map 7, Map of southwestern Indiana showing locations of active coal mines were revised. Other jobs finished during the year include a display for the Indiana State Fair, modification of a display showing publications by the Geological Survey, a group of sketches for geologic displays to be prepared by the State Museum, a series of sketches depicting various aspects of geology in Indiana for newspaper articles, a portrait drawing of Col. Richard Lieber for the office of the Director of the Department of Natural Resources, illustrations for five outside publications, and slide drawings for seven talks.

Drafting jobs presently in progress include: Bulletin 42-N, Petroleum industry in Indiana; Bulletin 53, Stratigraphy of the Detroit River Formation of northern Indiana; Bulletin \_\_\_\_, 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; State Park Guide 2, Geologic story of Clifty Falls State Park; and a display for the Indiana State Fair showing the history of mineral exploration in Indiana.

Photographic items produced during the year consist of 935 camera copies, 53 field photographs, 827 black and white prints, 511 film positives and duplicate negatives, 79 stripping film prints of stickup type and symbols, 8 scribesheets, 5 peelcost films, 13 color proofs of maps and covers, 175 color and tinted slides and 96 black and white slides.

## 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 groups, adult groups, and all persons interested in rocks, minerals, fossils and the earth. 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. In addition to giving public lectures and conducting special field trips, when requested, the Educational Services geologist works directly with teachers in public schools, geology clubs, Scout groups, 4-H clubs, conservation clubs, civic groups, and children throughout the school systems of the State on programs or projects concerning Indiana's geology and mineral resources. On occasion he serves as guest lecturer and conducts field trips for college classes. He identifies many of the rock, mineral, and fossil specimens sent to the Indiana Geological Survey through the mail from Indiana citizens. The geologist in charge of Educational Services also aids in the preparation and installation of exhibits 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. During the year, 18 more illustrations were prepared by the Geological Survey and a total of 875 mailings were made by the Educational Services geologist. Currently, six more illustrated news items are in process. During the 1974-75 fiscal year the geologist in charge of the Office of Educational Services spent 40½ days in the field and traveled more than 13,200 miles. In answer to requests received from the public, 13 public lectures were given and 5 special field trips and 7 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: Blackford County Rock and Mineral Society, Hartford City; Science class, Northwood Institute, West Baden; Social Studies class, Northwood Institute, West Baden; Annual Meeting of Hoosier Science Teacher's Association, Stouffer's Inn, Indianapolis; Lawrence County Rock Club, Bedford; Warren Central High School science classes (2 groups), Indianapolis; 5th grade class, School 93, Indianapolis; and 4th grade class, Broadview School, Bloomington.

Special field trips, collecting hikes, and tours were conducted for the following groups: Members of a Presbyterian Church Camp, near Bedford; a visiting reporter from the Indianapolis News; members of the Greene County Girl Scout Day Camp for 1975; 4th Grade Class, Childs School, Bloomington; members of a Social Studies class, Northwood Institute, West Baden; 8th Grade Class, Bedford Jr. High School, Bedford; a group

of Saudi Arabian teachers visiting Indiana University; members of Greene County Home Demonstration Clubs; and members of a science class, Bedford Jr. High School.

The Educational Services geologist also assisted in conducting a geologic field trip for members attending the Spring Meeting of the Indiana Academy of Science, held at Brown County Park. He also judged geology and weather for the Boone County 4-H Fair.

Articles submitted and published in OUTDOOR INDIANA included: "The Rockford Snake Rocks," by Carl B. Rexroad (July-August 1974); "Indiana's Ancient Reefs: Sources of Petroleum and Mineral Wealth", by Curtis H. Ault and R. Dee Rarick (November 1974); and "Indiana Geodes: Some of Nature's Mysteries", by R. Dee Rarick (March 1975).

During the past fiscal year the geologist in charge of Educational Services submitted 5 news releases to Indiana's newspapers about the activities of the Geological Survey. Also, he participated in 2 television programs concerning the Survey's activities in the field of mineral resources and Indiana geology.

Exhibits prepared by the Indiana Geological Survey for public display included a major exhibit for the 1974 Indiana State Fair and a smaller one that was taken to the annual meeting of the Illinois Basin Chapter of American Petroleum Institute, Division of Production, held in Evansville. Other Survey exhibits were installed in the Glendale Shopping Center, Indianapolis; the College Mall Shopping Center, Bloomington; annual rock show of the Indiana Gem and Geology Society, Indianapolis; annual rock show of the White River Geological Society, Anderson; annual meeting of the Hoosier Science Teacher's Association, Indianapolis; and the Wesselman Park Nature Center, Evansville.

The Educational Services geologist participated in the 20th 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.

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, and a Indiana Department of Public Instruction committee for the national Exploration Scholarship Program. The Educational Services geologist served as a member of this committee.

## GEOCHEMISTRY SECTION

During fiscal 1974-75, concern about the capabilities of the Geochemistry Section has grown for two major reasons. Increased needs and requests for utilization of the laboratories have been met with failure of equipment and a decrease in personnel. Upgrading and repair of present equipment necessary for routine analytical work could consume a discomfoting portion of available capital funds. True, inspiration of present personnel to be more vitally concerned with their work is desirable. Our recent loss of inefficient personnel and possible replacement with a vigorous interested employee could help considerably.

The major accomplishments of the section for the year have been the revision of the data files for brines and carbonate rocks, and the addition of data particularly on carbonate rocks and overburden materials from strip pits. One co-authored paper was submitted for outside publication. A normal number of requests for information, examination of samples from public and industry, and assistance to colleagues and students were handled.

Toward the end of the year the availability of hourly help increased, and routine work, particularly preparation of samples, was achieved more productively. In addition to a replacement in the professional category in the analyst/geochemist field, addition of a half or full-time sample preparator-curator would increase efficiency by decreasing time spent teaching routine operations.

Analysis of carbonate rocks should be continued to provide information leading to location of high quality materials for industry and for stratigraphic study and correlation, but an increased proportion of new data should be obtained for investigation of the possibility of location of metalliferous deposits, (primarily lead/zinc), the continuation of search for materials to be blended for cement manufacture, evaluation of potential oil shale, and evaluation of coal deposits from an inorganic geochemical approach as well as from the approach for fuel.

## GEOLOGY SECTION

The Section's accomplishments during 1974-75 may be summarized: The Geology Section worked actively on 14 formal projects and completed two of them (Environmental Geology of Allen and Hendricks Counties). Three of the 14 were begun as new projects (Environmental Geology of Morgan and Johnson Counties, Upper Salt Creek Valley Fill, and Engineering Properties of Unconsolidated Deposits). The greater effort (eight project was spent directly on environmental projects; other effort was placed on projects that have obviously direct applied or industrial significance (three projects), as well as scientific import, and still other effort (three projects) was more directly scientifically oriented.

After several years of concerted effort under the aegis "Environmental Geology", we probably now have our greatest reason to be encouraged--reason to feel that the effort may be worthwhile. Our environmental reports and maps may be coming to publication with some regularity, among them reports or maps on sedimentation in Lake Lemon, New Albany area, and Jeffersonville area. More than this, however, is the number of reports finished during 1974-75 and awaiting publication, among them Allen and Hendricks Counties; also, several other projects and reports were very nearly completed at the end of the reporting year, among them the Evansville area and Morgan, Johnson, LaPorte, and Marion Counties. We have also placed considerable effort in Monroe County, for some of which we will not be very visible, such as our role in providing data for several studies of land use in the area.

So many of the environmental projects have now come to fruition, if not yet publication, that we should now evaluate the program and redirect it, whether with greater, less, or the same efforts.

For that effort that was more research oriented, we note that we have during the past few years added a new dimension to our understanding of Silurian and Devonian stratigraphy (particularly subsurface) in Indiana. This effort has been carried on also by the Petroleum Section and Industrial Minerals Section.

In the nonenvironmental area, three projects could be considered as rather mature, although incomplete, inasmuch as several interesting papers were produced (on Pleistocene stratigraphy west-central Indiana, Middle Paleozoic geology northern Indiana, and Silurian reefs of northern Indiana).

The Section had 15 reports, 2 maps, and 3 abstracts published, 13 of these items being published by the Survey. All these items total 206 pages and 87 illustrative exhibitions, which is down some from the preceding year's production, but in the preceding year a large part of our activity was measured by the series of guidebooks produced for the field trips given for the general public. A continuing (from 1973-74) encouraging note is the fact that only three reports (324 p., 51 figs) that were more than one year old remained among the backlog. One year ago at this time, 17 reports and two maps (794 p., 110 figs.) remained that were more than one year old.

Members of the Section also had submitted for publication eight reports and four abstracts (152 p., 99 illus.) that remained unpublished at the end of the year. These reports, when added to the three remaining from earlier years brings our total backlog to 11 reports and four abstracts (476 p., 150 illus). These backlog figures are down from last year (20 reports, 860 p., 136 illus.).



Section staff prepared seven memorandum reports nearly all of which were environmentally oriented. Perhaps the most significant of these reports is the one dealing with planning needs for Jasper, Pulaski, Newton, and Starke Counties. The report listed for Hendricks County will become a published report. They also gave or conducted 18 papers, talks, and field trips. Three of the field trips were for professional organizations: Indiana-Kentucky Geol. Soc., Indiana Acad. Sci., and Indiana Geologists.

In addition, they were involved in 303 conferences and conference-type field trips of record, most of which reflect requests of us for information. This volume is slightly below that of last year, but requests by correspondence were greater. In each of the preceding two years we had noted an increase of 25 percent in conference activity.

During the past  $1\frac{1}{2}$  years we have been filing formal environmental impact statements for many highway construction and improvement projects in the state and for some other construction projects; during 1974-75 we completed 98 of record. This additional form of service request thus has resulted in our again placing a significantly increased effort in each succeeding year into answering service requests.

#### GEOPHYSICS SECTION

During the 1974-75 fiscal year the Geophysics Section maintained a program of field work, laboratory measurements, and development of computer programs to assist the interpretation of geophysical data. The volume of field work increased sharply during the year, mainly as seismic refraction surveys in connection with water resource studies. A seismic refraction crew worked throughout the year on numerous field surveys to measure the thickness of unconsolidated material above bedrock. These projects were concentrated in Shelby, Boone, Montgomery, Monroe, Marion, and Hendricks Counties and were done at the request of the Division of Water. Other seismic refraction shots were made in the same general areas in connection with environmental geology mapping being done by the Geology Section.

The first of a series of computer programs developed by the Geophysics Section to assist in the interpretation of data was published during the year. Two additional ones also were written and submitted for editorial review before publication in the Occasional Paper series. These reports dealt with seismic, gravity, and well log interpretations.

The Survey's drilling program was made much more efficient during the year by the modification of the Failing drill rig for wire line operations. Funds were provided by the Department of Natural Resources for obtaining reels, cables, pipe, core barrels, and other supplies and equipment for wire line coring. In the wire line method the core is hoisted to the surface without the necessity of removing the full string of drill pipe after each core run. The resulting operation has

proved to be faster and considerably easier to operate than conventional coring methods.

The section continued its study of probable ground motions that would be caused at points throughout the state by earthquakes of different sizes. A manuscript reporting the findings of this study was completed during the year and submitted for editorial review.

#### INDUSTRIAL MINERALS SECTION

Members of the Industrial Minerals Section have the responsibility for knowing the location of different non-fuel mineral commodities, their composition, and their present and probable future uses. This information has great economic significance for Indiana, particularly if it can be disseminated rapidly and applied to the practical problems of the mineral economy.

Five hundred and two requests for service were handled by the Section during 1974-75. This number was 6 percent below the 1973-74 record, but higher than any previous year. The decline in requests was mainly from the industry sector and probably reflected the overall business decline during 1974 and the first half of 1975. National figures collected by the U.S. Bureau of Mines indicate that production of cement, clay, gypsum, sand and gravel, and stone -- the principal industrial minerals produced in Indiana -- decreased between 5 and 9 percent in 1974 compared to 1973.

Research continued in environmental geology and the geology of sandstone, sand and gravel, and limestone and dolomite deposits. A new project was started on the occurrence of fluorite, sphalerite, and barite in Indiana.

The Section also began a new project to map the geology of Putnam County in detail. This work will provide new information concerning the aggregate industry in the county and will add geologic data for the county coal map series. Data obtained in the study also will be useful to provide answers to environmental questions as they arise.

Members of the Section spent an unusual amount of time during the year providing geologic information for legal problems. These involved condemnation suits in connection with a power plant site, the determination of the value of stone under stretches of new highway construction, and involvement in questions about bedrock beneath a new high school.

During the year members of the Section gave five public lectures, presented seven papers at professional meetings, conducted a field trip for the public, held 148 conferences with visitors, turned out five

memorandum reports on special projects, submitted two abstracts and four reports for outside publication, and prepared a special exhibit dealing with mineral resources. Don Carr, head of the section, was elected as an officer of the Industrial Minerals Division of the American Institute of Mining Engineers, and also was asked to write a review of industrial minerals for a national geologic publication.

#### MINERAL STATISTICIAN

The value of Indiana's mineral production in 1974 reached \$344 988 898.00 (reported at first stage of salability), an increase of 30 89 percent over the previous year. Higher unit prices accounted for this substantial increase, as only three of the State's seven major mineral commodities reported increased volume of production (see attached table)

The fuels -- coal petroleum and natural gas -- accounted for 71.07 percent of the total value of mineral production, and coal alone accounted for 58.77 percent.

The demand for coal to meet energy requirements is reflected in the fact that 13 new companies began operations during the year. The new Ayrshire mine in Warrick County, owned by AMAX, reached near-capacity production in 1974, and partially counteracted the effects of a miners' strike during the last two months of the year.

Drilling was carried on at a sharply accelerated pace during 1974, but oil production continued to decline, although at a much lower rate than in the previous year. The total value for oil produced during 1974 was more than double that of 1973.

The construction materials -- sand and gravel, crushed limestone, dimension limestone, clay and shale, gypsum, and dimension sandstone -- accounted for 28.70 percent of the total value of mineral production.

Crushed limestone produced for all purposes other than for agricultural use showed a very slight decrease in volume.

Reports from the dimension limestone industry indicate the first increase in the amount of stone quarried each year since 1967, when

large shipments of relatively inexpensive stone for breakwater were made. Optimism prevailed in the industry late in 1974 when two contracts totalling \$2.5 million were signed. Also late in the year, work was started on a monumental carving of "Washington Crossing the Delaware", to be mounted at Washington Crossing, Pennsylvania. This Bicentennial project of the town of Bedford has been described as the most ambitious local project in the nation.

Sand and gravel showed some increase in both volume and dollar value. Because of a change in method of reporting, it has been difficult to determine in which categories increases or decreases took place, but it appears that less material was produced for both building construction and road construction, and more for fill and other purposes.

Pike, Sullivan, Vermillion, and Warrick Counties accounted for 48.87 percent (not including oil and gas) of the total value of all mineral commodities produced in Indiana during 1974. 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>Mineral Commodities (in alphabetical order)</u>
<u>\$20 million+</u>			
Warrick	\$76,990,484	-----	Coal
Pike	44,360,484	-----	Coal
Vermillion	24,453,252	C	Clay and shale, clay products, coal, sand and gravel
Sullivan	22,816,938	-----	Coal, crushed limestone, sand and gravel
<u>\$10-20 million</u>			
Greene	\$18,067,498	C	Clay and shale, clay products, coal, sand and gravel
<u>\$5-10 million</u>			
Clay	\$9,109,478	\$16,393,673	Clay and shale, clay products, coal

<u>County</u>	<u>Value-Raw Materials</u>	<u>Value (including mfd. products)</u>	<u>Mineral Commodities (in alphabetical order)</u>
<u>\$5-10 million</u>			
Spencer	\$7,766,900	-----	Coal
Hamilton	6,048,689	-----	Crushed limestone, sand and gravel
Putnam	5,927,481	C	Cement, clay and shale, crushed limestone, dimension limestone, sa and gravel
Lawrence	5,504,990	21,064,227	Cement, clay and shale, crushed limestone, dimension limestone, sand and gravel
Marion	5,362,663	-----	Crushed limestone, sand and gravel
Crawford	C	-----	Crushed limestone
Clark	5,154,508	C	Cement, clay and shale, crushed limestone, sand and gravel

In 16 counties, including six listed above, additional processing of and manufacture of products from mineral resources (cement, clay products, and dimension limestone) added almost \$97.5 million to the total value of mineral production.

Related industries, those manufacturing lime, recovering sulfur, and expanding perlite, all from raw materials imported from other parts of the country, added additional millions of dollars to the value of the total mineral industry of Indiana.

	1973		1974	
	<u>Quantity</u>	<u>Value</u>	<u>Quantity</u>	<u>Value</u>
Coal	25,207,269 tons	\$152,756,048	24,253,632 tons	\$202,760,364
Crushed limestone	30,604,496 tons	48,175,634	30,249,556 tons	53,781,363
Sand and gravel	25,173,871 tons	31,993,239	25,421,227 tons	34,694,330
Petroleum	5,312,096 bbls	20,823,416	4,919,380 bbls	42,405,056
Dimension limestone	2,337,552 cu.ft.	3,698,792	2,487,177 cu.ft.	5,144,481
Clay and shale	1,322,412 tons	1,522,744	1,317,296 tons	1,980,271
Peat	112,951 cu.yd.	386,290	166,920 cu.yd.	821,448
Natural gas	276,400,000 cu.ft.	38,400	176,300,000 cu.ft.	23,900
Undistributed - includes dimension sandstone, gypsum, marl, and whetstones		<u>4,165,668</u>		<u>3,377,685</u>
TOTAL		\$263,565,231		\$344,988,898
Value added for additional processing of dimension limestone and manufacture of clay products and cement		\$92,030,522		\$97,412,686

## 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 326 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 for publication in the Survey's Mineral Economic Series was completed.

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

Review of Petroleum Exploration Map Series. -- Transparencies of county petroleum maps were up-dated at year's end. Thirty-eight maps were revised and 54 were checked with no revisions necessary.

## Records Improvement

Stratigraphic Test Holes. -- In May the section completed a three year project of acquiring data on stratigraphic test holes that have been drilled by the oil industry during the past 25 years. The information on these tests consists of driller's logs, samples, and geophysical logs. Records from a total of 2,955 holes drilled in 49 counties have been added to the Petroleum Section files. Of this total, 348 locations have been field checked and records from these wells have been incorporated in the master file of well records; these 348 wells also have been symbolized on the Petroleum Exploration maps. The remaining well records have been placed in a separate file which is available for public use, although locations and elevations for these wells have not been verified in the field. This project has resulted in the availability of additional subsurface information.

Gibson County Well Records. -- With the help of additional personnel, it has been possible to accelerate project for upgrading Gibson County well records. The project is now 75 percent complete.

Aerial Photos. -- Newly acquired aerial photographs for 23 counties in Indiana were catalogued and incorporated into the existing Survey file by Paul Dubois.

## Subsurface Studies

A study of the Pre-Knox rocks in Indiana has been completed. A manuscript entitled "Pre-Knox (Cambrian) Stratigraphy in Indiana" by Leroy E. Becker, A. J. Hreha, and T. A. Dawson was submitted in May for review and publication. This project, started in 1970, involved the study of 121 deep wells in Indiana, and about 50 deep wells in bordering states.

## Special Projects

The Petroleum Industry in Indiana, Bulletin 42-N. -- Work was completed on Bulletin 42-N entitled "The Petroleum Industry in Indiana", by G. L. Carpenter, T. A. Dawson, and Stanley J. Keller. The manuscript has been approved for publication and final drafting has been completed. The report is scheduled for publication in late 1975. It offers a significant contribution to the history and development of the petroleum industry in Indiana.

The Plummer Field, Greene County, Indiana. -- In October 1974, Dr. James A. Noel, a faculty member on leave from Wright State University, began conducting a research project on the Plummer Field under the auspices of the Geological Survey. Most of the study was performed in the Petroleum Section. However, some of the data were gathered at Citizens Gas and Coke Utility office at Lonetree. A preliminary report with work maps, cross sections and charts was completed in December 1974. The displays were refined by Paul Dubois of the Petroleum Section and the manuscript submitted to critical readers in May 1975.



Map Showing Oil and Gas Fields in Indiana. -- A new map showing the oil and gas fields in Indiana by Gerald L. Carpenter and Dan Sullivan was started in early 1975. All the petroleum exploration maps showing oil and gas fields were reduced in scale, and the fields scribed onto a 1:500,000 base. Copies of Bulletin 50 entitled "Silurian and Devonian Rocks in Indiana Southwest of the Cincinnati Arch", by Leroy E. Becker were received from the printer in May.

Silurian Sedimentary Facies. -- The section participated in a study of the Silurian in Indiana. The results of the study were presented in a paper entitled "Evolution of Middle and Late Sedimentary Facies: Illinois to Michigan Basin", by L. E. Becker, J. B. Droste, and R. H. Shaver at the Regional GSA meeting at Waterloo, Ontario in May.

Miscellaneous Map. -- A map showing the thickness of Silurian strata and the distribution of Silurian reefs is being prepared by Stanley J. Keller and Leroy E. Becker.

AAPG Oil and Gas Field Data Bank and Map Project of North America.-- Work on the AAPG sponsored project of compilation of the Indiana portion of a North American oil and gas field map and data bank was completed during August 1974 by G. L. Carpenter and Paul Dubois.

Mount Simon Sandstone Project. -- The geological investigation of the Mount Simon Sandstone for the Ohio River Valley Sanitation Commission (ORSANCO) was completed in October 1974 by Leroy E. Becker and A. Hreha.

Reservoir Maps. -- Fourteen colored work maps showing producing reservoirs in oil and gas wells in southwestern Indiana were completed by Paul Dubois.

Sample Consolidation. -- A project to consolidate well samples was initiated in January 1975. During the first four months of 1975 one employee was assigned to the project. Two additional employees were added in May. As of 1 July the group had consolidated 1,500 wells. Based upon the average filing in recent years, the vacant space created by consolidation of 1,500 wells adds four years to the life of the sample file. The project is 15 percent complete.

## PUBLICATIONS SECTION

During the past fiscal year the Publications Section sold 6,835 reports and 12,333 maps. The section sent 2,834 reports and 57 maps on exchange to institutions in the United States and in foreign countries. It also distributed without charge 3,286 reports and 1,681 maps to members of its own organization and to individuals, libraries, and companies in the United States and abroad. The Publications Section served 4,388 office customers, handled 3,174 letters pertaining to geologic reports and maps, and sent out 1,201 announcements of new publications.

Eighteen reports, two new maps, and 54 revised maps were issued during the fiscal year. In addition, five reports and two maps were reprinted. A new series, Occasional Papers, was introduced late in the fiscal year 1973-74; it was an especially active series in 1974-75, as 10 reports were issued as Occasional Papers. Another new series, State Park Guides, was introduced early in the fiscal year 1974-75; the first number in this series, "Geologic Story of Pokagon State Park, Legacy of Indiana's Ice Age," was published in July 1974.

## REPORTS AND MAPS PUBLISHED BY THE GEOLOGICAL SURVEY

### Bulletins

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Ault, C. H., and Carr, D. D., 1975, Directory of crushed stone, ground limestone, cement, and lime producers in Indiana: 28 pg., 1 fig.

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### Mineral Economics Series

Carpenter, G. L., and Keller, S. J., 1974, Oil development and production in Indiana during 1973: Mineral Economics Ser. 20, 23 p., 3 figs, 5 tables.

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Droste, J. B., and Orr, R. W., 1974, Age of the Detroit River Formation in Indiana: Occasional Paper 5, 5 p., 2 figs, 1 table.

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#### Reports of Progress

Shaver, R. H. and Smith S. G., 1974, Some Pennsylvanian Kirkbyacean ostracods of Indiana and Midcontinent series terminology: Rept. Prog. 31 59 p., 3 pls., 5 figs.

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Hill, J. R., 1974, The Indiana Dunes--Legacy of sand: Spec. Rept. 8, 9 p., 1 pl., 10 figs.

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#### State Park Guides

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#### County Base Maps

Purcell R. L., 1974, Base map of Gibson County, Indiana: Base Map 26 (revised).

#### Miscellaneous Maps

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Extension Agent and Dept. of Nat. Res.

Gray, H. H., August 13, 1974, Geology of the Greens Bluff area,  
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A preliminary geologic evaluation of mineral resources and land-use  
parameters in Newton, Jasper, Pulaski, and Starke Counties, 12 p.,  
8 figs., for Kankakee-Iroquois Regional Planning Commission.

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impact assessment for the Potato Creek State Recreation area, 8 p.,  
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## PUBLIC LECTURES

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Patton J. B., The interruptible contract between Nature and society, Nonrenewable resources and nonrenewable civilizations, Mini University, Bloomington, June 16, 1975.

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Powell, R. L., Rock mechanics study of roof rock in underground coal mines, Class in hydrogeology, Dept. of Geosciences, Purdue, October 16, 1974.

Powell, R. L., Caves of Indiana, Spring Mill State Park for Naturalists, May 14, 1975.

Powell, Cave exploring in southern Indiana, WTTV interview, November 7, 1974.

## PUBLIC FIELD TRIPS

Gray, H. H., Carr, D. D., and Powell, R. L., Stratigraphy of the Stephenson Groups, Perry and Crawford Counties, for Indiana-Kentucky Geol. Soc., May 30, 1975.

Hill, J. R., to Indiana Dunes, for the Indiana Geologists, May 10, 1975.

Rexroad, C. B., Hill, J. R., and Ratick, R. D., A 250-million year jaunt from Weed Patch Hill (Brown Co.), spring field trip for Indiana Acad. Sci.

Shaver, R. H., Silurian reefs in Ohio, Indiana, Illinois, for Getty Oil Co. geologists of Houston, May 26-30, 1975.

## ACTIVITIES

Leroy Becker -- Served as member of the Potential Gas Committee, a group that considers potential or undiscovered gas reserves.

Gerald Carpenter -- Participated in the work of the AAPG Committee on Statistics of Drilling and developed oil and gas drilling statistics for Indiana.

Donald Carr -- Secretary-Treasurer of the Industrial Minerals Division, Society of Mining Engineers of AIME.

Member Education Committee, Society of Mining Engineers of AIME.

John Patton -- Elected President of the Indiana Academy of Science. In connection with that office, participated in annual meeting of Indiana Science Education Foundation Board, Indianapolis; spoke at luncheon for winners in Indiana Science Talent Search, Indianapolis; and presided at Spring Meeting, Brown County State Park.

Served on Committee C-18, Natural Building Stones, of American Society for Testing and Materials.

Member of Research Committee of Interstate Oil Compact Commission.

Participated in symposium sponsored by the U.S. Geological Survey and Kentucky Geological Survey in Lexington, Kentucky, January 9 - 10, 1975.

Member of Governor's Energy Committee.

Co-Chairman of Energy Task Force, Lt. Governor's Science Advisory Committee.

Member of Agricultural Land Use Task Force, Midwest Governor's Conference, which met three times in Chicago. Was chairman of group which drafted policy statement.

Dan Sullivan -- Served as member of SPI National Committee on Reserves and Productive Capacity.

Member of API Subcommittee, Tri State Area.