

109TH ANNUAL REPORT OF THE STATE GEOLOGIST

of

INDIANA GEOLOGICAL SURVEY  
DEPARTMENT OF NATURAL RESOURCES

for

July 1, 1984 - June 30, 1985

GEOLOGICAL SURVEY  
ONE HUNDRED AND NINTH ANNUAL REPORT OF THE STATE GEOLOGIST

PERMANENT PERSONNEL

Administration

John B. Patton . . . . . State Geologist  
Maurice E. Biggs . . . . . Assistant State Geologist  
Mary E. Fox. . . . . Mineral Statistician  
E. Coleen George . . . . . Principal Secretary

Coal and Industrial Minerals Section

Donald D. Carr . . . . . Geologist and Head  
Curtis H. Ault . . . . . Geologist and Associate Head  
Donald L. Eggert . . . . . Geologist  
Denver Harper. . . . . Geologist  
Nancy R. Hasenmueller. . . . . Geologist  
Walter A. Hasenmueller . . . . . Geologist  
Paul N. Irwin (OSM). . . . . Geologist  
Christopher Schubert (USGS). . . . . Geologist  
Nelson R. Shaffer. . . . . Geologist  
Christopher R. Smith . . . . . Geologist  
Belita J. Minett . . . . . Secretary  
Kathryn R. Shaffer . . . . . Secretary

Drafting and Photography Section

William H. Moran . . . . . Chief Draftsman and Head  
Barbara T. Hill. . . . . Photographer  
Richard T. Hill. . . . . Senior Geological Draftsman  
Roger L. Purcell . . . . . Senior Geological Draftsman  
\*Kimberly H. Sowder. . . . . Draftsperson/Photographer  
Wilbur E. Stalions . . . . . Artist/Draftsman  
\*\*James R. Tolen . . . . . Senior Geological Draftsman

\*Salary paid in part from Department of Geology account  
\*\*Salary paid from Department of Geology account

Educational Services

John R. Hill . . . . . Geologist and Head

### Geochemistry Section

Richard K. Leininger . . . . . Geochemist and Head  
Margaret V. Ennis . . . . . Instrumental Analyst  
Joseph G. Hailer . . . . . Geochemist  
Louis V. Miller . . . . . Coal Chemist  
Jimmy J. Johnson . . . . . Electronic Technician  
Belita J. Minett . . . . . Secretary

### Geology Section

Robert H. Shaver . . . . . Paleontologist and Head  
Ned K. Bleuer . . . . . Glacial Geologist  
Gordon S. Fraser . . . . . Geologist  
Samuel S. Frushour . . . . . Geologic Technician  
(From September 10, 1984)  
Henry H. Gray . . . . . Head Stratigrapher  
Edwin J. Hartke . . . . . Environmental Geologist  
Carl B. Rexroad . . . . . Paleontologist  
Martha N. Smith . . . . . Secretary

### Geophysics Section

Maurice E. Biggs . . . . . Geophysicist and Head  
Robert F. Blakely . . . . . Geophysicist  
Joseph F. Whaley . . . . . Geophysicist  
Thomas W. Chitwood . . . . . Geophysical Assistant  
E. Coleen George . . . . . Principal Secretary  
Samuel L. Riddle . . . . . Driller

### Petroleum Section

Gerald Carpenter . . . . . Geologist and Head  
Brian D. Keith . . . . . Geologist  
Stanley J. Keller . . . . . Geologist  
John A. Rupp . . . . . Geologist  
Dan M. Sullivan . . . . . Geologist  
Peggy A. Bassett . . . . . Senior Records Clerk  
(To October 12, 1984)  
Jerry Burton . . . . . Geological Assistant  
James T. Cazee . . . . . Geological Assistant  
Sherry Cazee . . . . . Geological Assistant  
Shelley S. Fox . . . . . Senior Records Clerk  
(From October 15, 1984)  
Patsy Starks . . . . . Secretary and Curator of Records



Other Personnel

Coal and Industrial Minerals Section

Doug Alcalá . . . . .Laboratory Assistant  
(May 5, 1985 to June 29, 1985)

Christine Alert . . . . .Laboratory Assistant  
(August 26, 1984 to April 20, 1985)

Jay Arnold . . . . .Geological Assistant  
(July 1, 1984 to June 30, 1985)

Daniel Auerbach . . . . .Laboratory Assistant  
(August 26, 1984 to April 20, 1985)

David Barnhart (USGS) . . . . .Laboratory Assistant  
(August 26, 1984 to June 30, 1985)

Thomas Brown . . . . .Laboratory Assistant  
(September 9, 1984 to May 4, 1985)

David Burke (OSM) . . . . .Laboratory Assistant  
(July 1, 1984 to September 8, 1984)

Christine Buttimer . . . . .Laboratory Assistant  
(August 26, 1984 to April 20, 1985)

Angela Drerup . . . . .Laboratory Assistant  
(August 26, 1984 to April 20, 1985)

David Elliott (USGS) . . . . .Laboratory Assistant  
(August 26, 1984 to May 4, 1985)

Gerald Fitzgerald . . . . .Laboratory Assistant  
(February 10, 1985 to April 6, 1985)

Michael Furfaro (OSM) . . . . .Laboratory Assistant  
(June 2, 1985 to June 29, 1985)

Jennifer Gilles (OSM) . . . . .Laboratory Assistant  
(July 1, 1984 to December 29, 1984)

Julie Gordon (OSM) . . . . .Laboratory Assistant  
(May 5, 1985 to June 1, 1985)

Lori Jelenick (OSM) . . . . .Programmer  
(July 1, 1984 to June 30, 1985)

William Kersey . . . . .Laboratory Assistant  
(August 26, 1984 to February 23, 1985)

John Kopicik . . . . .Laboratory Assistant  
(August 26, 1984 to December 15, 1984)

Christopher Kopec (USGS) . . . . .Laboratory Assistant  
(July 1, 1984 to July 28, 1984)

Lisa Locke (OSM) . . . . .Laboratory Assistant  
(July 1, 1984 to August 25, 1984)

Michael Meyer . . . . .Laboratory Assistant  
(August 26, 1984 to December 15, 1984)

Denis Michaud (OSM) . . . . .Laboratory Assistant  
(December 16, 1984 to June 1, 1985)

Laura Mosby . . . . .Laboratory Assistant  
(July 1, 1984 to April 20, 1985)

Melissa Perucca . . . . .Laboratory Assistant  
(May 19, 1985 to June 30, 1985)

Percy Pompey . . . . .Laboratory Assistant  
(May 5, 1985 to June 15, 1985)

Tom Reynolds (USGS) . . . . .Laboratory Assistant  
 (July 1, 1984 to August 11, 1984)

Amy Roberts. . . . .Laboratory Assistant  
 (July 1, 1984 to September 8, 1984)

Kathleen Shannon (OSM) . . . . .Laboratory Assistant  
 (January 27, 1985 to June 29, 1985)

Brent Shean. . . . .Laboratory Assistant  
 (July 1, 1984 to March 9, 1985)

Randall Sippel (USGS). . . . .Laboratory Assistant  
 (July 1, 1984 to June 30, 1985)

Thomas Skirvin (OSM) . . . . .Laboratory Assistant  
 (September 9, 1984 to April 6, 1985)

Mike Sowder (OSM). . . . .Laboratory Assistant  
 (June 16, 1985 to June 30, 1985)

Eugene Spicer. . . . .Laboratory Assistant  
 (July 1, 1984 to July 14, 1984)

Laurie Sullivan. . . . .Laboratory Assistant  
 (May 5, 1985 to June 17, 1985)

John Tazbir. . . . .Laboratory Assistant  
 (August 26, 1984 to June 1, 1985)

Victoria Warren (USGS) . . . . .Laboratory Assistant  
 (July 1, 1984 to June 30, 1985)

Licia Weber (OSM). . . . .Laboratory Assistant  
 (July 1, 1984 to June 30, 1985)

Magdalen Welch . . . . .Laboratory Assistant  
 (August 26, 1984 to April 20, 1985)

Eric Wilkinson . . . . .Laboratory Assistant  
 (August 26, 1984 to March 23, 1985)

Rea Williams . . . . .Laboratory Assistant  
 (July 1, 1984 to July 28, 1984)

Drafting and Photography Section

S. Vincent Minnick . . . . .Drafting Assistant  
 (August 27, 1984 to April 17, 1985)

James S. Struhs. . . . .Drafting Assistant  
 (May 5, 1985 to June 28, 1985)

Geochemistry Section

Owen Blevins . . . . .Laboratory Assistant  
 (September 9, 1984 to January 26, 1985)

Brett Carney . . . . .Laboratory Assistant  
 (September 23, 1984 to April 20, 1985)

Laura Cathcart . . . . .Laboratory Assistant  
 (August 26, 1984 to May 4, 1985)

Michael Furfaro. . . . .Laboratory Assistant  
 (September 9, 1984 to June 29, 1985)

Andrew Hardy . . . . .Laboratory Assistant  
 (January 13, 1985 to April 20, 1985)

Debra Heuser . . . . .Laboratory Assistant  
 (August 26, 1984 to December 1, 1984)

Laura Hogarth. . . . .Laboratory Assistant  
(August 26, 1984 to May 4, 1985)  
Desiree Meyers . . . . .Laboratory Assistant  
(January 13, 1985 to April 20, 1985)  
Gerald Michael . . . . .Laboratory Assistant  
(August 26, 1984 to April 6, 1985)  
Melissa Mick . . . . .Laboratory Assistant  
(July 1, 1984 to August 25, 1984)  
Randy Oakley . . . . .Laboratory Assistant  
(July 1, 1984 to December 1, 1984)  
Richard Presley. . . . .Laboratory Assistant  
(July 1, 1984 to June 29, 1985)  
Jenny Tankersley . . . . .Research Assistant  
(July 1, 1984 to November 17, 1984)  
Susan Taylor . . . . .Laboratory Assistant  
(August 26, 1984 to December 29, 1984)  
Thomas Toth. . . . .Laboratory Assistant  
(January 27, 1985 to June 1, 1985)  
Rick Truex . . . . .Laboratory Assistant  
(August 26, 1984 to November 17, 1984)

Geology Section

Mark Abney . . . . .Laboratory Assistant  
(January 11, 1985 to April 19, 1985)  
Robert Autio . . . . .Field Assistant  
(July 1, 1984 to August 3, 1985)  
Annette Winter Bottum. . . . .Geological Assistant  
(January 17, 1985 to May 16, 1985)  
Michael Brauner. . . . .Laboratory Assistant  
(September 6, 1984 to October 23, 1984)  
David Dick . . . . .Laboratory Assistant  
(August 26, 1984 to April 9, 1985)  
Gregory Dipple . . . . .Field Assistant  
(July 1, 1984 to August 22, 1984)  
(October 26, 1984 to January 8, 1985)  
(May 5, 1985 to June 30, 1985)  
Paul Ehrstein. . . . .Laboratory Assistant  
(July 1, 1984 to December 6, 1984)  
Jeffrey Frey . . . . .Field Assistant  
(July 1, 1984 to August 6, 1984)  
(November 21, 1984 to November 23, 1984)  
Samuel Frushour. . . . .Laboratory Assistant  
(July 1, 1984 to September 7, 1984)  
Jennifer Gilles. . . . .Geological Assistant  
(November 19, 1984 to December 20, 1984)  
Julie Gordon . . . . .Laboratory Assistant  
(August 28, 1984 to May 3, 1985)  
Dennis Grah. . . . .Laboratory Assistant  
(August 28, 1984 to April 3, 1985)  
Deborah Heidt. . . . .Geological Assistant  
(September 10, 1984 to December 18, 1984)  
Randy Kline. . . . .Laboratory Assistant  
(August 29, 1984 to April 30, 1985)

Maureen Kusmiss. . . . .Laboratory Assistant  
 (January 28, 1985 to May 1, 1985)  
 Martin Lytle . . . . .Laboratory Assistant  
 (August 29, 1984 to June 30, 1985)  
 Norma Mackay . . . . .Computer Programmer  
 (November 6, 1984 to November 15, 1984)  
 William Nellist. . . . .Geological Assistant  
 (July 1, 1984 to August 22, 1984)  
 (May 6, 1985 to June 28, 1985)  
 Jenny Tankersley . . . . .Research Assistant  
 (July 1, 1984 to June 30, 1985)  
 Julie Warren . . . . .Laboratory Assistant  
 (August 27, 1984 to April 19, 1985)  
 Bruce Wilcer . . . . .Field Assistant  
 (July 1, 1984 to August 1, 1984)  
 Geological Assistant  
 (August 30, 1984 to June 30, 1985)

#### Geophysics Section

Cynthia Anderson . . . . .Programmer  
 (May 5, 1985 to June 30, 1985)  
 William Gaddis . . . . .Field Assistant  
 (May 5, 1985 to June 30, 1985)  
 James Hetmer . . . . .Programmer  
 (September 9, 1984 to September 22, 1984)  
 Joseph Loyall. . . . .Programmer  
 (May 5, 1985 to June 30, 1985)

#### Petroleum Section

Shawn Boehm. . . . .Laboratory Assistant  
 (August 27, 1984 to April 20, 1985)  
 James Cheesman . . . . .Geological Assistant  
 (July 2, 1984 to August 10, 1984)  
 Pamela Dubois. . . . .Clerical Assistant  
 (July 2, 1984 to June 28, 1985)  
 John Federle . . . . .Laboratory Assistant  
 (August 28, 1984 to April 20, 1985)  
 Paul Hickner . . . . .Laboratory Assistant  
 (July 5, 1984 to August 24, 1984)  
 (June 17, 1985 to June 28, 1985)  
 Kevin McKee. . . . .Geological Assistant  
 (April 30, 1985 to June 29, 1985)  
 Michelle Moss. . . . .Clerical Assistant  
 (July 5, 1984 to August 25, 1984)  
 Jeff Swanson . . . . .Laboratory Assistant  
 (August 28, 1984 to April 6, 1985)

## COAL AND INDUSTRIAL MINERALS

### INTRODUCTION

Members of the Section answered 1024 requests for information during the year, nearly 200 more than in the previous year. The Section's geologists conducted research on 32 projects to define the geology of the state and to find and evaluate the state's mineral resources. Section geologists investigated the coal resources of six counties in southwestern Indiana and studied the effects of the past mining of coal on surface subsidence and groundwater quality. Several years of data gathering on the locations and areas of past mining in the state resulted in the publication of 11 maps in a series that shows the location and extent of surface and underground coal mines in Indiana. These maps include information from many sources and are the only places where all the available mine data are collected.

The potential for producing synthetic oil from Indiana shale continued to attract industry and government interest. Research by geologists of the Section helped evaluate shale-oil possibilities in rocks of Devonian, Mississippian, and Pennsylvanian age and helped delineate areas with the most potential for development. The programs to evaluate oil shale in Indiana had been expanded last year to include black shales above Pennsylvanian coals, and this year additional samples were obtained from outcrops, mines, and cores to determine the potential of the Pennsylvanian black shales, which mostly directly overlie minable coals and are now wasted in all mining operations. Some of the higher oil yields in Indiana are from these shales, and it is believed that they are a viable future resource.

Many requests were received for information on our research and file data of the limestone and dolomite, clay, and sand and gravel resources of the state. Brightness measurements on the limestone and dolomite of the state were of particular interest to industry during the year, and our drilling of a reef in Grant County and examination of deepened rock sections in limestone and dolomite quarries added to our knowledge of limestone and dolomite resources. The sale of several quarries in southeastern Indiana this year was marked by use of our detailed file data on the quarries by several prospective buyers. The owner of five of the quarries asked the Survey to provide geologic and chemical data to prospective buyers because our files were much more complete than his.

In other mineral-industry developments, past and recent research by Section members influenced several industrial undertakings during the year including the successful start-up and operation of a fine-grind limestone plant in Grant County, the location of two projects in southeastern Indiana to recover synthetic oil from shale, and the advanced planning for a tile-making plant in south-central Indiana.

Geologists of the Section contributed to and kept abreast of professional developments by attendance at numerous professional conferences, by publication of 27 maps, abstracts, and research papers concerning Survey research, and by participation in the administration and activities of local and national geological organizations.

## COMPLETED PROJECTS OR MAJOR PARTS OF PROJECTS

Potential for synthetic oil from the New Albany Shale  
Report on correlation of major coals in the Illinois Basin  
Coal resources of Sullivan County  
Roof stability and geologic discontinuities in coalbeds  
Hydrogeochemical reconnaissances of Washington and Lawrence Counties  
Eleven coal maps of counties showing surface and underground mines  
Directory of sand and gravel operators  
Directory of dimension-stone operators  
Directory of abrasives, ceramic, clay and shale, and gypsum producers in  
Indiana

## RESEARCH PROJECTS

### CLAY AND SHALE

#### General

Numerous samples from cores, mine exposures, and outcrops of clay, underclay, and shale were collected. Some samples were sent to the U.S. Bureau of Mines for ceramic analysis. Mineralogic analyses of samples and limited chemical analyses were made, and efforts to develop an X-ray diffraction method to determine the total mineralogy of these rocks were continued. Several professional papers were prepared, and research continues, particularly on geochemical and ceramic studies.

#### Pennsylvanian black shales

Many samples of Pennsylvanian black shales were collected and analyzed this year to determine mineralogy, chemistry, and oil yield. A report was made to the Department of Energy, and several professional papers were prepared detailing the results. A further study to determine why weathered shales show higher oil yields was started, and several cores were taken to obtain unweathered samples.

#### New Albany Shale

Detailed drilling information and several cores of the New Albany in several counties in southeastern Indiana were donated to the Survey this year. This information and that obtained from cores drilled by the Survey allowed for continued detailed stratigraphic studies of the shale in southeastern Indiana. A report on the potential for synthetic oil from the New Albany was completed, and a summary of oil-shale developments in the state was written for publication in a national journal. A search to find an iridium anomaly in the New Albany was begun.

## Pennsylvanian stratigraphy

This general project of the Coal and Industrial Minerals Section includes studies and contributions from all members of the section. This year members of the Section completed revisions and additions to a compendium of rock-unit stratigraphy, which is now in preparation. Three members of the Section continued activities on a tri-state committee to correlate Pennsylvanian rock units in the Illinois Basin, and preparations were made to construct detailed cross sections in the Dugger Formation in southwestern Indiana.

## COAL

### Deep drilling program for coal

Information on deep coal resources of southwestern Indiana is gathered through this project. Fifteen holes were drilled in six counties in previous years, and an additional hole has now been scheduled for drilling in Posey County. The information obtained, which is released to the public after each hole is drilled, has proved useful in assessing resources and mining conditions for possible underground mines.

### Preliminary coal maps of Posey, Greene, and Owen Counties

Reconnaissance mapping of the distribution, structure, and mined areas of coal are shown on these maps. Collection of drilling data, correlation of economic coals, and construction of the map for Owen County continued. The completed map for Greene County was being drafted for publication, and evaluation of shallow and deep coals continued in Posey County.

### Coal resources of Gibson County

This project was nearly completed this year. Data gathering and mapping of the Seelyville Coal Member of the Staunton Formation, the Survant Coal Member of the Linton Formation, and the Hymera and Danville Coal Members of the Dugger Formation occupied much of the research time. Maps for the project were completed, and a number of maps constructed for the project were placed on open file and sent to interested persons.

### Coal resources of Vanderburgh County

Work continued on determining the distribution, thicknesses, and stratigraphic relationships of coalbeds in the northern part of Vanderburgh County. Several stratigraphic cross sections were compiled, including one showing the presence of a sand-filled channel in the Dugger Formation in northeastern part of the county, which would affect the mining of this coal in that part of the county.

### Coal resources of Sullivan County

This project was completed. The coal geology and mining history of the county were discussed in the report, and work began on preparation for publication of the report with maps showing the structure, thickness, and geologic irregularities of major coals.

### Coal resources of Vigo County

The report for this completed project awaits only final drafting before publication.

### Goals of the Mansfield and Brazil Formations

The objective of this project is to map and evaluate the coal resources in the Mansfield and Brazil Formations. Work this year focused on identifying and mapping the distribution and structure of marker beds such as the Lead Creek Limestone Member to establish the stratigraphic framework needed for regional correlation of the coals.

### Roof stability and geologic discontinuities in coalbeds

This project was completed with a report summarizing discontinuities and showing photographs, sketches, and descriptions of problem areas in several underground mines.

### Subsidence caused by underground mining of coal

This continuing study of the causes and location of subsidence in underground mines in Indiana was advanced through the drilling of boreholes through subsidence features in the Blackhawk reclamation project in Vigo County. Cores from the holes will be studied to determine characteristics of fractures in these features, and the holes may be used in future dye-tracing experiments.

### Demethanization of coal

This continuing study will determine the methane content of coalbeds in Indiana using desorption methods developed by the U.S. Bureau of Mines. As cores of coal are drilled with the Survey's drilling rig, degasification of the coal is conducted.

### Reference section of the Survant and Houchin Creek Coal Members (Linton and Petersburg Formations)

Correlation of the Survant and Houchin Creek Coal Members continues along with an investigation of stratigraphic relationships of these coals with the Springfield and Coalchester Coal Members of the Petersburg and Linton Formations.

### Geologic conditions in underground mines in the Survant Coal Member (Linton Formation)

Work began on a report summarizing geologic and mining conditions encountered during past underground mining in the Survant coal of Indiana. The report is based in large part on a study of mine-map notations from the Survey's large file of mine maps. The report is intended to be the first in a series summarizing underground mining conditions encountered during past mining in several of Indiana's important coalbeds.

### Indiana coal-data system

A large amount of data was placed on computer files and recorded for this overall project, which included three separate projects, two of which are discussed below. The three projects are the collection of point-source data for the USGS, the compilation of data on abandoned mines, and the review and recalculation in part for the Survey's coal analyses file, which was entered into the data system.

### Mine-map project (OSM funded via Division of Reclamation)

A new published map series, "Coal Maps," was started during the year, and more than 350 maps were distributed. The maps, showing the extent of surface and underground mines, were published on newly drafted county base maps on a scale of 1 inch equals 1 mile. Mapping was completed in 45 quadrangles showing surface coal mines and in 4 quadrangles showing underground mines. Data on surface mines continued to be entered into our files, and progress was made entering all of the information into a computer database.

### Point-source data for the National Coal Resources Data System (USGS funded)

Maps and data for entry into the U.S. Geological Survey's computer files for all counties in southwestern Indiana were completed this year. This information, which includes point-source coal data and coal-extent information derived from drilling records, coal samples, outcrop descriptions, mine maps, published maps, and miscellaneous maps, will be used for calculations of Indiana's coal resources.

### Blackhawk reclamation project (OSM funded via Division of Reclamation)

This 3-year study combines an evaluation of groundwater flow and determination of water chemistry at the Blackhawk Mine in Vigo County. This first year of the project included a study of the hydrologic and other processes associated with mine subsidence. Thirty wells were drilled in and near the reclamation site, water samples were taken, and water levels were monitored. Samples collected from an abandoned underground mine near the site were analyzed for evidence of leakage between the reclamation site and the mine in attempt to detect bedrock fracturing due to mine subsidence.

## GEOLOGY AND STRUCTURE OF INDIANA

### Geologic map of Indiana

The map for this project, the joint effort of geologists from three Sections of the Survey, was drafted for publication.

### Faulting and jointing

Studies of jointing directions and effects, particularly in quarries, continued in conjunction with other projects and as time permitted.

### Faulting in mines of southwestern Indiana

The report for this completed project was published by the U.S. Nuclear Regulatory Commission, and copies of the report were distributed to interested geologists and other persons.

### Maps of Indiana showing structure on top of the Muscatatuck Group and rocks of Silurian age

Two maps on a scale of 1:500,000, one showing structure on top of Silurian strata and one showing structure on top of the Muscatatuck Group (Middle Devonian), continued to be compiled.

### Annotated bibliography of Indiana geology

During the past year a final review of the bibliography for the period from 1956 to 1975 was made. Compilation of references for the period from 1976 to 1985 continued.

## LIMESTONE AND DOLOMITE

### Silurian reefs in northern Indiana

Survey drill hole 335, drilled near Marion, Grant County, was drilled in the flank of a reef that is a possible source of crushed-stone aggregate. The above information and information from deepened sections in quarries was used to help evaluate reefs in northern Indiana as sources of aggregate and high-calcium limestone.

### Carbonate rock fillers and whiting

Information was gathered on brightness, chemical composition, and geologic occurrence for limestones and dolomites in Indiana. Methods of improving whiteness of limestones were investigated. We received many industry requests for data on this continuing project.

### Stylolite minerals

The collection of outcrop samples continued. Minerals found within the stylolites included pyrite, dolomite, and quartz. Scanning electron microscopy and X-ray diffraction methods were used to help identify many of the very fine-grained to microscopic mineral forms.

### METAL DEPOSITS

A total of about 700 samples had been collected by the end of the year for a hydrogeochemical reconnaissance of Washington and Lawrence Counties. Rock samples were also collected and analyzed, and reports were prepared for the counties. A similar study for Monroe County was started, and several new occurrences of ore minerals were recorded.

### METEORITES

Collection of photographs of Indiana meteorites continued with the goal of amassing a complete file of photographs. A number of talks were given on the subject, and several requests for identification of possible meteorites were received.

### MINERAL RESOURCES OF INDIANA

Indiana Survey Miscellaneous Map 41, "Map of Indiana showing locations of coal and industrial minerals operations," was published.

### SAND AND GRAVEL

#### Sand and gravel directory

The directory of sand and gravel operators was revised, and copies were distributed.

#### Sand and gravel resources of Daviess County

Alluvial deposits along the forks of the White River were test drilled, and samples were analyzed by grain size to determine potential sand and gravel resources. Writing was started on the final report for the project.

## 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 publishing, preparation of displays, mounting and framing of maps and photographs, phototypesetting, diazo printing, photocopying, film processing and printing, photomacrography, field photography, color proofing of maps and artwork, and preparation of projection slides.

Jobs completed for publication by the Geological Survey are: Special Report 33, Trepostome Bryozoa from the Dillsboro Formation (Cincinnatian Series) of Southeastern Indiana; Special Report 34, Coal Mining in Vigo County, Indiana; Occasional Paper 45, Indiana Gravity Base Network, 1981; Occasional Paper 46, Data Base for Deep Wells in Indiana; Occasional Paper 47, Lithostratigraphy of the Sauk Sequence in Indiana; Occasional Paper 48, Sedimentology of the Coal Creek Fan, Fountain County, Indiana; Occasional Paper 49, Generation of Vertically Incident Seismograms; Occasional Paper 50, Volgelgnathus, a New Mississippian Conodont Genus; Mineral Economics Series 30, Oil Development and Production in Indiana During 1983; Directory of Clay and Shale Producers in Indiana; Directory of Dimension Stone Quarriers in Indiana; Directory of Sand and Gravel Producers in Indiana; Miscellaneous Map 42, Map Showing Bedrock Topography of the Teays Valley, Western Part, North-Central Indiana; Miscellaneous Map 43, Map Showing Bedrock Topography of the Teays Valley, Central Part, North-Central Indiana; Miscellaneous Map 44, Map Showing Bedrock Topography of the Teays Valley, Eastern Part, North-Central Indiana; Miscellaneous Map 45, Map of Indiana Showing Thickness, Extent, and Oil and Gas Fields of Trenton and Lexington Limestones; Petroleum Exploration Map 79, Well Location Map of Jay County, Indiana; Petroleum Exploration Map 79A, Well Location Map of Jay County, Indiana, Showing Total Depth of Wells; Coal Map 1, Map of Vanderburgh County, Indiana, Showing Locations of Underground Coal Mines (scale 1:63,360); Coal Map 2 (Warrick Co.); Coal Map 3 (Perry Co.); Coal Map 4 (Gibson Co.); Coal Map 5 (Pike Co.); Coal Map 6 (Dubois Co.); Coal Map 7 (Knox Co.); Coal Map 8 (Daviess Co.); Coal Map 9 (Sullivan Co.); Coal Map 10 (Greene Co.); Coal Map 11 (Vigo Co.); and revision of the series of petroleum exploration maps of Indiana counties.

New base maps were prepared from mosaics of topographic quadrangle maps, reduced to 1-inch to 1-mile, for use in the new Coal Map Series and the Petroleum Exploration Map Series. The base maps completed are Daviess, Dubois, Gibson, Greene, Jay, Knox, Martin, Perry, Pike, Spencer, Sullivan, Vanderburgh, Vigo, and Warrick counties. Other jobs completed include a map showing published petroleum exploration maps, a geologic map of Indiana for a postcard, a group of maps requested by the Lieutenant Governor for a State Fair display, a cover and maps for a new publications list, a cover and illustrations for the geologic story of Wyandotte Cave, a display for the Indiana State Fair; poster displays for meetings of the Indiana Academy of Science, American Association of Petroleum Geologists, Kentucky Oil and Gas Association, and Indiana Coal Mining Institute; a display on coal mining for the Geology Building; slides for 10 talks; and illustrations for 7 papers for publishing in journals and in the proceedings of meetings of geologic organizations.

Other jobs in progress include Special Report 35, Surface Coal Mining in Indiana; Special Report \_\_, Geology and Coal Deposits of the Clinton Area, West-Central Indiana; Special Report \_\_, Alluviation of the Ohio Valley Near Evansville, Indiana; Occasional Paper \_\_, Environmental Geologic Considerations in Koontz Lake, Starke County, Indiana, and Its 6-Mile Fringe; illustrations for a paper to be published in the Proceedings of the Geology Highway Symposium; maps of 6 counties showing underground coal mines for the Coal Map Series; a display on petroleum for the Geology Building; and a display for the 1985 Indiana State Fair.

Photographic items produced consist of 1401 camera copies, 33 field photographs, 18 photomicrographs, 1137 black and white prints, 741 film positives and contact negatives, 196 stripping film prints of stick-up type and symbols, 58 scribesheets, 101 peelcoat films, 9 color proofs of maps and artwork for covers, and 383 slides.

Approximately 53,900 square ft. of prints were produced on the diazo printer.

## EDUCATIONAL SERVICES SECTION

### General Functions

The Educational Services Section functions primarily as a liaison between the Indiana Geological Survey and the private and business sectors. This service includes the dissemination of information about industrial minerals, Survey research programs, and the general geologic makeup of Indiana. Recipients of this information include the public schools (middle school through high school), universities and colleges, the media, other divisions within the Department of Natural Resources, and the general public on a request basis. Special-interest organizations, such as rock clubs, 4-H groups, and speleological societies, also seek information from this office. Included in the section duties is the conception of displays that are used at fairs, rock shows, and geologic meetings.

Preparation of news releases, magazine articles, Geological Survey publications, field-trip guidebooks, and general-information memorandum reports is also a function of the Educational Services geologist. This material varies in content from nontechnical/popular publications to the results of geologic research.

During fiscal 1984-85, the Educational Services geologist recorded 347 conferences, 11 field trips, and 326 items of correspondence with private individuals, the media, businesses, and educational institutions. Most of these items were answers to requests for information, including the identification of rock, mineral, and fossil specimens.

The Educational Services geologist is continuing research in the field of Quaternary geology and geomorphology that was begun earlier in the Geology Section. A long-standing project that treats the glacial geology of northwestern Indiana remains to be completed. New work that will include some research is underway. The origins and geomorphic history of the Norman Upland

is part of a study being done for a publication on the scenic uplands of Indiana. The revision and updating of "Gold and Diamonds in Indiana" was begun this past year.

#### Status of Projects

##### Slide file

This is an ongoing project designed to provide detailed 35-mm color-slide coverage of a variety of geologic subjects. Specific subjects for which complete, or nearly complete, slide files already exist include: caves of Indiana, the coal industry, the gypsum industry, the petroleum industry, geophysical research, Quaternary geology, the lime industry, the dimension-stone industry, and the physiography of the Norman Upland. Completed since April of this year are the seismic-refraction field program and the Norman Upland.

A detailed photographic coverage was made of the Blackhawk Mine study--a cooperative research effort being conducted by the Division of Reclamation and the Geological Survey.

Subject matter within each of the separate files is constantly updated as new information, techniques, and equipment make such photography necessary.

##### Our Hoosier State Beneath Us

The first newspaper briefs under the general title "Our Hoosier State Beneath Us" were released in February 1974. Since that time, the Educational Services Section has generated, with help from other Survey staff, 213 separate releases covering nearly every topic of geologic interest in Indiana. Although the series has not been abandoned, the rate at which new releases are being prepared has been slowed because most of the reasonable subject matter has already been adequately covered.

##### Scenic uplands of Indiana

This project is intended to be published in three parts, one each is to discuss the landforms typical of the Norman, Crawford, and Dearborn Uplands. Work is currently underway on the Norman Upland.

The general theme of these reports, which are to be published in the Circular series, will be the excelling beauty of these rolling regions of Indiana. Photographic work that will be used in the report on the Norman Upland has begun. More than 48 black and white photographs and 80 color slides are now in hand.

## Gold and Diamonds

Revision of Blatchley's classic paper "Gold and Diamonds in Indiana," was begun this past year. The revision will include a historical section that will be similar to Blatchley's, an updated interpretation of the origins of the gold and diamonds, a section on occurrences, and some technical information on the amounts of gold that can be expected from the Holocene alluvium of Salt Creek in northern Brown County.

To date, the section on origins of the gold and diamonds is completed in rough draft. Some field work has also been completed.

## Special Field Trips

The following field trips were wholly or partly prepared and conducted by the Educational Services geologist: (1) A series of six 45-minute lectures were given on the local geology of Fern Cliff in Putnam County. The lectures and group discussions were a part of an outing for the Greencastle Middle School. (2) A guidebook was prepared and a field trip was run for the spring meeting of the Indiana Academy of Sciences. The field trip, "Geologic tour of the Brown County State Park and Helmsburg Areas," included stops at various places in Brown County State Park and at a road cut on the west side of Helmsburg. (3) A number of short field trips that traversed a part of the Mitchell Plain karst region were run for several local schools. (4) Perhaps the most significant field trips were those run for the School of Education (IU Bloomington). Two geomorphology trips were offered for Education majors and another, which was part of the IU "Prime Time" series, was run for middle-school teachers who represented schools throughout Indiana.

## Lectures

The following lectures were given: four lectures on the caves of Indiana to students at Edgewood Jr. High School, Ellettsville; a talk to the Girl Scouts about geodes, rocks, and minerals (Lake Lemon, Monroe County); the origins of caves to Bloomington school children; lecture on the origins of geodes and the geology of the Norman Upland to a group of "gifted and talented" middle-school children who were attending a special IU seminar on the sciences; a series of lectures on the geology of Putnam County was given to middle-school students from the Greencastle Middleschool; a series of lectures on the origins of the Knobstone Escarpment and the Pleistocene history of Brown County was given to participants in the Spring Indiana Academy of Sciences Field Trip; a lecture on the origins of soils was given to students at Arlington Heights School (Bloomington); lectures to several groups about the geology of Lost River and the Beech Creek Limestone at the Lost River Forestry Field Day; lectures as visiting scientist at a special colloquium at Indiana State University on the subject of "Geologic Materials as Potential Confinements for Hazardous Wastes in Indiana;" lectures to a group from Manchester College on the dimension stone industry and the geology of the Mitchell Plain.

## Miscellaneous

The Educational Services Section geologist, with help from Drafting and Photography Section staff, worked on the 1985 State Fair exhibit for the Geological Survey.

A new coal display was designed and prepared for the east display case in the first floor lobby. Construction of the display was mostly the work of the Drafting-Section illustrator. The new coal display replaces the gypsum display that had occupied that case for the past 20 years. Replacement of the Petroleum Section display is next on the agenda.

One edition of the Survey Newsletter was written and distributed to Survey staff and friends.

Information was prepared for use in the distribution of public-information packets. This effort included the revision, printing, and duplication of maps, printed stratigraphic columns, and reprints. Other items prepared for public distribution included photographs and rock specimens.

The Educational Services Geologist, with help from the Geology Section, consulted on the competence of parts of the bedrock formations that crop out at McCormicks Creek State Park. The information, which included the inspection and evaluation of the Ste. Genevieve and St. Louis Limestones along the canyon of McCormicks Creek just down stream from the falls, was requested by Mr. Job, property manager at McCormicks Creek.

A list of earth-science movies was prepared, and some of the films on the list were reviewed. The resulting annotated film file will be used in answering requests about the availability of such films. Work on this project, which was begun last fiscal year, continues.

A postcard bedrock geologic map of Indiana has been prepared by the section geologist and is soon to be published.

## GEOCHEMISTRY SECTION

In association with the Coal and Industrial Minerals Section, the Geochemistry Section began a project of monitoring groundwater, primarily, at a site of reclamation in the coal mining area of the state. This project has provided the Survey with new analytical tools, especially an ion chromatograph with integrator, a fluorometer, and a laboratory pH-ion meter as well as field instruments for measurement of parameters of water quality. Laboratory analytical procedures were studied and implementation begun. Use of the inductively coupled plasma spectrometer has simplified the determination of cations.

We are also participating with the Division of Water in a regional water quality project in the St. Joseph River Basin. We trained and equipped their personnel in sampling and simple field measurements, and do their laboratory analyses. We will cooperate in the interpretation of the results and in final report preparation.

The work on oil shale continued, resulting in a joint paper (Nelson Shaffer and Richard Leininger) on Pennsylvanian oil shales in Indiana given at the Eastern Oil Shale Symposium. Leininger also gave a paper on the variability of the New Albany Shale at Pac Chem meeting cosponsored by the American Chemical Society in Honolulu. Another similar talk was presented to the Illinois Geological Survey seminar. A gift of many cores of the New Albany Shale by Phillips Petroleum was cataloged and stored; description of the core was started. A report on the shale by Nancy Hasenmueller and Richard Leininger was submitted for publication by the Survey.

A project was carried out and the report is being prepared on stains and their removal from Indiana Limestone building stone. Support for this project was provided by the Indiana Limestone Institute of America, Inc.

Routine preparation and analysis of samples, mostly of cores, was continued. Lou Miller supervised or carried out 951 and 3003 determinations of CO<sub>2</sub> and sulfur, respectively. Peg Ennis supervised or ran 7302 CHN determinations on 2434 samples and made 2360 spectrographic determinations in 143 samples. Numerous miscellaneous x-ray, microscopic and chemical determinations were made for Survey geologists in conjunction with research or inquiry by the public.

## GEOLOGY SECTION

### Orientation and General Activities

The Geology Section is charged with collecting, storing, interpreting, and disseminating stratigraphic (including glacial stratigraphic) and paleontologic information on the several thousand feet of sedimentary rocks that everywhere mantle the State.

Users of this information regularly include private citizens, professional geologists and their organizations, educational organizations, commercial and industrial concerns, and governmental agencies of local to federal scope. Particularly during the last two decades of public awareness of the natural environment, the Section's applied activities have greatly increased in direct response to requests from the user groups noted above.

During the 1984-85 year, the section recorded 440 conferences and special field trips and 1223 items of correspondence, much of these accountings referable to user requests. In addition, 171 environmental questionnaires were completed and 8 special memorandum reports were prepared. The former category relates to construction projects that use federal and local funds for (in order of decreasing frequency): bridge replacement and construction, road and street repair and construction, industrial expansion, sewer and water projects, miscellaneous construction, and power installation.

Some of the items noted above as conferences, special field trips, and correspondence may be classified as educational activities, and to them may be added one of the emphases in the 21 papers, posters, and public lectures delivered by members of the Section; three formal field trips led by Section personnel and an article in Outdoor Indiana also qualify.

During the year the Section carried on 10 regularly listed formal projects (one of which has several formal subprojects). One project and one subproject were completed. Two other projects (on general character and engineering properties of unconsolidated materials) are not included in the tallies above, but they were carried on through field-based augering, sampling, and logging programs and through a multiple-sedimentological testing program in the Sedimentation Laboratory. For example, in all these programs these statistics apply: rock and fossil collections, 753; number of holes and footage gamma-ray logged, 32 and 4660; holes and footages augered, 37 and 1694; sections and footages measured, 42 and 1356; and laboratory tests, 2752. These statistically stated results were drawn on for several of the projects described farther on.

#### Status of Projects

##### Quaternary map of Indiana

This project was begun in 1982-83 but had not seen rapid progress until the year now ended, when it became 60 percent completed. This progress virtually assures completion in 1985-86. Such completion will signify the end of a much larger program first planned during the 1950's. With a new Quaternary map, the state will be covered by an admirable series of eight 1° X 2° maps (scale, 1:250,000), four single sheet wall maps (scale, 1:500,000), and four page-size maps. These maps separately and partly collectively portray Paleozoic and Quaternary geology, drift thickness, and bedrock topography.

In relation to Quaternary mapping mentioned above, an adjunct map was published by the U.S. Geological Survey: Quaternary geologic map of the Chicago 4° X 6° Quadrangle, United States, the Indiana part of which being our compilation (see "Misc. Pubs.," Lineback and others item).

##### Quaternary stratigraphic and sedimentologic studies

A great deal of field effort went into the collection of descriptive stratigraphic data on the great central Indiana till plain (mentioned as statistics in the general introduction), a part of which applies to two long-standing projects on Quaternary stratigraphy: (1) Pleistocene stratigraphy of west-central Indiana and (2) The Teays Valley of Indiana. (See two formal items identified to Bleuer and Fraser, and to Miller, McCoy, and Bleuer under "Misc. Pubs.")

Seven subprojects in Quaternary sedimentology were carried on, one being completed during 1984-85: (1) Lake Michigan sedimentation, (2) Ohio Valley alluviation, Vanderburgh County (completed), (3) Middle Wabash Valley alluviation, (4) Whitewater River terrace deposits, (5) Kankakee valley dune sands, (6) Daviess County glacial lake deposits, and (7) White River sedimentation. Five separately listed formal results of these studies are found under "Reports . . . Published . . ." (Fraser and Fishbaugh item), "Misc. Pub." (three items by Fraser, Fraser & Bleuer, and Fraser, Larsen, & Hester), and "Reports . . . Submitted . . ." (Fraser item).

Reports for two miscellaneous Quaternary activities are listed under "Reports . . . Published . . .," Culbertson and Gray item, and under "Misc. Pubs.," Gray item.

### Biostratigraphy and other paleontologic activities

Conodont biostratigraphic studies were actively carried on under the aegis of three separate projects based on Ordovician, Silurian, and Mississippian circumscriptions. Formally listed evidences for these and other (informal) conodont activities may be found elsewhere in this annual report under "Misc. Pubs.," items variably identified to Rexroad and others, including Merrill, Horowitz, Nicoll, Shaver, and Droste and under "Reports and Maps Submitted . . .," items identified to Rexroad and others, including Ethington, Droste, Norby, and Merrill. A part of the results apply to subsurface correlation problems, and another part permits more esoteric interpretations to be made relative to paleoecology and paleogeography.

Still another biostratigraphic study, based on three microfossil groups and stemming from an at least temporarily completed project was published. See under "Misc. Pubs.," Shaver item relating to interregional Pennsylvanian (Atokan) correlation.

A monographic report on Dillsboro (Cincinnatian) bryozoans of Indiana, was published (see "Reports Pub. . . . by Survey," Brown and Daly item).

Biostratigraphic studies also included investigation of amino acid materials (from molluscs) in Quaternary deposits of Indiana and their use for age determination. One abstract and one complete report were presented. (See under "Misc. Pubs.," item identified to Miller, McCoy, and Bleuer, and under "Reports Submitted . . .," a similarly identified item.)

### Paleozoic stratigraphic activities

The project begun in October 1983 and entitled "Revision of the Compendium on Rock-Unit Stratigraphy in Indiana" was completed with submission of a new compendium manuscript keyed to the Paleozoic systems only (see "Reports Submitted . . .," item identified to Shaver and others). The post-Paleozoic, mostly Quaternary stratigraphic units in Indiana were not treated because the present state of flux in their classification suggested a later and separate treatment.

Under "Reports . . . Published . . .," the report identified to Rexroad and Lane is an adjunct to the completed compendium project.

Under "Misc. Pubs.," the chart identified to Shaver and others relates to a major effort in interregional correlation that was completed in an earlier year.

Two substantial reports relating separately to middle Paleozoic stratigraphy of the Illinois and Michigan Basins, and to projects once considered as completed, were prepared as requested efforts. (See under "Reports . . . Submitted . . .," items identified to Droste and Shaver and item identified to Shaver.)

The project on subsurface Mississippian rocks of northwest Indiana, begun in June 1983, was furthered by the acquisition and logging of additional cores from the Warren County area and by the preparation (for study) of conodont-bearing samples.

### Environmental geology and other applied activities

The Section carried on only one formal project in this category, "Environmental geology of Monroe County," the final report on which neared completion at the end of the year. A new project of this kind was planned for Tipton and Hamilton Counties in the so-called Kokomo-Indianapolis corridor that is culturally and industrially expanding at a rapid pace.

A large part of the Section's activities reported as statistics and mentioned in the general statement above are environmentally oriented. In addition the Section prepared on request eight memorandum reports (which see under that title). The more significant of these relate (1) to the State's cooperative (with Michigan and Ohio) bid to have the U.S. Department of Energy's projected Superconducting Super Collider constructed in the tristate area and (2 and 3) to the Indiana Division of Water's new program to assess water resources in nine Indiana drainage basins. (See under "Memo. Repts.," three items collectively identified to Bleuer, Fraser, Hartke, and Rexroad.)

Other activities of the environmental, educational, and otherwise requested type are noted under "Memo. Repts.," Gray and Shaver items; "Field Trips," three Bleuer, Fraser, and Shaver items; and under "Repts. . . . Submitted . . .," two Bleuer and Gray items.

### Miscellaneous activities

Members of the Section collectively presented 21 formal lectures (posters, talks), conducted 3 field trips, attended 9 professional meetings (counted by man attendances), reviewed 30 professionally prepared manuscripts, and served on 7 outside professional committee (panel, study, session) groups. Also, one member served as president of his special-research society.

### GEOPHYSICS SECTION

Work continued during the year on the gravity survey of Indiana. A report presenting data that will enable future workers to coordinate gravity surveys with all other gravity stations in the state was published in September, 1984. It is Occasional Paper 45, "Indiana Gravity Base Network, 1981" by Joseph F. Whaley. This report provides values of the absolute acceleration due to gravity for 106 base stations located throughout Indiana with a spacing density of approximately 1 station per county. Gravity values for the base network were determined by ties to International Gravity Bureau gravity stations in Louisville, Kentucky and Chicago, Illinois.

Joe Whaley and a field assistant, Bill Gaddis, surveyed gravity stations in east-central and northeastern Indiana from May 9 through the end of the fiscal year. During that time approximately 1,275 stations in a relatively closely spaced pattern of a one-mile grid were occupied in Allen, Adams, Wells, Blackford, and Jay Counties. These gravity measurements will become part of the state's gravity data bank. When complete, these data will provide gravity coverage equivalent to the aeromagnetic survey of Indiana. The latest work is intended to cover the northeastern quarter of Indiana. The remaining portion of northern Indiana will require another two years to complete.

In July 1984 a seismic party consisting of Joe Whaley, Gary Pavlis, Terry Stigall, and Maurice Biggs continued a seismic project near Bargersville to study the decay of seismic waves in overburden materials. The rate at which seismic waves are attenuated in unconsolidated deposits may allow us to determine thickness and type of these materials. The Failing drill rig was used to drill two tests holes to bedrock in order to test results of seismic attenuation shots made near Paragon.

In his role as the Geological Survey's expert on computing, Bob Blakely participated in research projects for other sections and agencies. These projects included continued development of an information retrieval system for the Petroleum Section; processing of geochemical laboratory and well data to assist the Geochemistry Section; preparation of a scheme to plot geophysical logs to different scales in both dimensions for the Geology Section; development of an invoice program for the Publications Section and work on an inventory control system; and assistance for geologists from the Department of Natural Resources Division of Water to produce digitized map information, and use that information to compute areas of land on the basis of usage within a drainage basin.

#### MINERAL STATISTICIAN

Overall, calendar year 1984 was a very good one for the mineral industries in Indiana. The total value (at first stage of salability) was \$1,207,407,417.00 -- an increase of 10.57 percent over the previous year. The manufacture of cement and clay products, and the milling of limestone for building purposes, contributed an additional \$130,000,000.00-plus. The value of the mineral industries to the state was additionally enhanced a substantial number of millions of dollars by the manufacture of lime, the recovery of sulfur, and the processing of perlite -- all from materials imported from out of state.

Because many companies failed to submit reports on their production, most total figures used in this report contain estimates based on earlier returns, our knowledge of the companies, and the general trend of the industry.

Coal continued as the major commodity, accounting for 74.60 percent of the total value of all minerals produced in the state. Of all the coal reported from 15 counties, production in Warrick and Pike Counties accounted for 43.80 percent.

Drilling for oil declined slightly from 1983, but production increased by 1.40 percent, attributable to waterflood operations. The lower per-barrel price in 1984 resulted in a decline of 2.74 percent in the total value of oil produced during the year.

The fuels -- coal, oil, and natural gas -- accounted for 87.40 percent of the total value of minerals produced. Materials used mainly in construction -- clay and shale, gypsum, crushed limestone, dimension limestone, and sand and gravel -- accounted for 12.50 percent.

Production of clay and shale increased 22.25 percent in quantity and 39.28 percent in total value, and the total value of the brick, drain tile, lightweight aggregate, etc., manufactured from the clay and shale increased 53.07 percent.

Crushed limestone, quarried and processed for agricultural purposes, building and road construction, cement manufacture, and various other uses, showed an increase of 11.77 percent in volume and 11.53 percent in value.

Although data from a number of companies are lacking, it appears that 1984 was a good year for the operators in the Lawrence and Monroe Counties building stone district. Total value of the stone at first stage of salability increased approximately 13 percent, and the total value of milled stone increased approximately 30 percent. The same cannot be said for operations outside of Lawrence and Monroe Counties, where stone is produced for veneer, flagging, and other uses. Production declined nearly 30 percent in volume and approximately 21 percent in total value.

Although firm figures are not available, it appears that cement manufacture resulted in rather substantial gains in both quantity and total value.

Sand and gravel production showed an increase of 5.40 percent in quantity and 9.10 percent in total value.

The following counties led in minerals production (exclusive of oil and gas and of mineral commodities produced from imported materials):

<u>County</u>	<u>Value at first stage of salability</u>	<u>Mineral Commodity (in alphabetical order)</u>
<u>\$100 million+</u>		
Warrick	\$244,853,660.00	Coal
Pike	149,628,876.00	Coal
Daviess	107,093,756.00	Coal
<u>\$50-100 million</u>		
Greene	82,740,742.00	Coal, crushed limestone, sand and gravel
Vermillion	68,154,524.00	Clay and shale, coal, sand and gravel
Knox	62,531,451.00	Coal, sand and gravel
Clay	58,060,020.00	Clay and shale, coal
Sullivan	51,603,409.00	Coal

\$25-50 million

Spencer	35,203,640.00	Coal
---------	---------------	------

\$5-25 million

Martin	18,905,655.00	Coal, gypsum
Dubois	16,380,459.00	Clay and shale, coal
Crawford	- C -	Crushed limestone
Hamilton	11,776,714.00	Crushed limestone, peat, sand and gravel
Lawrence	9,994,736.00	Crushed limestone, dimension limestone
Clark	9,286,689.00	Clay and shale, crushed limestone, sand and gravel
Marion	8,932,224.00	Crushed limestone, sand and gravel
Owen	8,783,217.00	Coal, crushed limestone, sand and gravel
Vigo	7,871,600.00	Coal, sand and gravel
Putnam	7,710,750.00	Clay and shale, crushed limestone, dimension lime- stone, sand and gravel
Allen	6,390,176.00	Crushed limestone, peat, sand and gravel
Monroe	5,585,101.00	Crushed limestone, dimension limestone

PETROLEUM SECTION

During the year both the technical and professional staff of the Petroleum Section met with the general public and representatives of the petroleum industry. Visitors to the section numbered 574 and many requests by telephone or correspondence were routinely handled by the staff. Incoming letters to the section numbered 590 during the year.

An article reviewing drilling and exploration activities in Indiana was prepared for inclusion in the Bulletin of the American Association of Petroleum Geologists.

Revision of the Petroleum Exploration Maps was effected during the year. One new map was published, 93 were revised, and 31 were checked with no revision being necessary.

Statistics on drilling in Indiana are prepared and submitted to a joint committee of the American Association of Petroleum Geologists and the American Petroleum Institute. The Indiana statistics become a part of the nationwide drilling statistics published by the AAPG.

Estimates of the undiscovered potential gas reserves are revised annually and submitted to the Potential Gas Committee for publication as part of the potential gas reserves for the nation. The committee publishes a revised figure annually.

A summary of petroleum development and production statistics by fields was prepared and published in the Survey's Mineral Economics Series during the year.

Microfilming of incoming new well data for the year was effected and microfiche copies were placed in a file separated from the master file of well data as a safeguard against possible loss of information.

Several hearings conducted by the Department of Natural Resources, Division of Oil and Gas concerning the protection of coal seams encountered in drilling oil or gas wells in Indiana were attended by professional staff of the Petroleum Section.

Progress was made on preparation of the formal projects underway by the professional staff members. By the end of the fiscal year the projects underway ranged from 75 to 95 percent completed. Most, if not all of them are expected to be submitted for publication prior to the end of the next fiscal year.

#### PUBLICATIONS SECTION

During the past fiscal year the Publications Section sold 6,943 reports and 13,356 maps. The section sent 1,963 reports and 19 maps on exchange to institutions in the United States and in foreign countries. It also distributed without charge 2,060 reports and 1,236 maps to members of its own organization and to individuals, libraries, and companies in the United States and abroad. The Publications Section served 5,055 office customers, handled 3,568 incoming and 2,393 outgoing letters pertaining to geologic reports and maps, and sent 892 announcements of new publications.

Eleven reports, 15 new maps, and 92 revised maps were issued during the fiscal year, and one map was reprinted. A new publications list was also issued near the end of the fiscal year.

Nine manuscripts of Survey reports, 18 abstracts and 22 manuscripts prepared by Survey personnel for outside publication, and 15 news releases, newsletters, exhibits, and similar material were edited during the fiscal year. Camera copy for 15 miscellaneous projects was prepared.

The editing and a final review of the "Annotated Bibliography of Indiana Geology--1956 Through 1975" were completed during the fiscal year. Camera copy will be prepared by the secretaries in the Coal and Industrial Minerals Section and the Geology Section using IBM personal computers and an IBM Wheelwriter 5. The annotated bibliography will be published in the Bulletin series during the 1986 calendar year. The annotating and indexing of post-1975 reports and maps pertaining to Indiana geology will be continued during the 1985-86 fiscal year.

A double postal card was sent to all individuals and institutions on the general announcement list to bring this file up to date. Individuals and institutions that no longer wanted announcements or that failed to reply by a specified date were removed from the file. As a result, 892 announcements of new publications were sent during the 1984-85 fiscal year compared with 1,427 announcements sent during the 1983-84 fiscal year.

An IBM personal computer and a Diablo 630 communications terminal, which were installed in the Publications Section in December 1982, were used for invoicing and for maintaining general announcement and gratis and exchange files. Preparation of a program for maintaining accounts receivable was in progress, and a program for maintaining inventory was considered but was not started.

REPORTS AND MAPS PUBLISHED BY THE GEOLOGICAL SURVEY

Directories

Carr, D. D., and Ault, C. H., 1985, Directory of dimension stone quarriers in Indiana: Indiana Geological Survey Directory, 13 pages, 1 figure.

Shaffer, N. R., and Carr, D. D., 1984, Directory of abrasives, ceramic, clay and shale, and gypsum producers in Indiana: Indiana Geological Survey Directory, 14 pages.

Mineral Economics Series

Carpenter, G. L., and Keller, S. J., 1984, Oil development and production in Indiana during 1983: Mineral Economics Series 30, 48 pages, 3 figures, 5 tables.

Miscellaneous Maps

Keith, B. D., 1985, Map of Indiana showing thickness, extent, and oil and gas fields of Trenton and Lexington Limestones: Miscellaneous Map 45. Scale, 1:500,000, in color.

Shaffer, N. R., 1984, Map of Indiana showing locations of coal and industrial minerals operations: Miscellaneous Map 41. Scale, 1:500,000, in color.

Occasional Papers

Rexroad, C. B., and Lane, N. G., 1984, Spickert Knob Formation (new), Borden Group: Occasional Paper 43, 4 pages, 2 figures.

Culbertson, Glenn, and Culbertson, J. A., 1984, Time required for the erosion of Clifty and Butler Ravines; with introduction and commentary by H. H. Gray: Occasional Paper 44, 7 pages, 2 plates, 2 figures.

Whaley, J. F., 1984, Indiana Gravity Base Network 1981: Occasional Paper 45, 34 pages, 7 figures, 8 tables.

Bassett, P. A., and Keith, B. D., 1984, Data base for deep wells in Indiana: Occasional Paper 46, 29 pages, 1 plate, 2 tables.

Droste, J. B., and Patton, J. B., 1985, Lithostratigraphy of the Sauk Sequence in Indiana: Occasional Paper 47, 24 pages, 18 figures, 4 appendix illustrations.

Fraser, G. S., and Fishbaugh, D. A., 1985, Sedimentology of the Coal Creek Fan, Fountain County, Indiana: Occasional Paper 48, 7 pages, 4 figures.

Frazer, L. N., Bates, D. L., and Rudman, A. J., 1985, Generation of vertically incident seismograms: Occasional Paper 49 (Geophysical Computer

Program 10), 62 pages, 13 figures, 15 tables.

#### Petroleum Exploration Maps

Sullivan, D. M., Enochs, L. G., and Cazeem, J. T., 1985, Well location map of Jay County, Indiana: Petroleum Exploration Map 79. Scale, 1 inch equals approximately 1 mile.

Sullivan, D. M., Enochs, L. G., and Cazeem, J. T., 1985, Well location map of Jay County, Indiana, showing total depth of wells: Petroleum Exploration Map 79A. Scale, 1 inch equals approximately 1 mile.

Revised Petroleum Exploration Maps (as of December 31, 1984): 3A, 3B, and 3C (Warrick County); 4A, 4B, and 4C (Sullivan County); 5A and 5B (Vigo County); 12, 12A, and 12C (Martin County); 13A, 13B, and 13C (Greene County); 14A and 14B (Clay County); 15A (Parke County); 16A (Vermillion County); 17A (Fountain County); 18A (Owen County); 21A, 21B, and 21C (Dubois County); 22A (Jackson County); 23, 23A, and 23C (Knox County); 24A (Monroe County); 25A (Lawrence County); 26, 26A, and 26C (Daviess County); 28A and 28C (Crawford County); 30 and 30A (Harrison County); 32A (Bartholomew County); 36A (Johnson County); 38A (Warren County); 39, 39A, and 39C (Spencer County); 40, 40A, and 40C (Perry County); 42A (White County); 46A (Jennings County); 48A (Scott County); 49A (Clark County); 50A (Floyd County); 51, 51A, and 51C (Pike County); 52, 52A, and 52C (Vanderburgh County); 53, 53A, and 53C (Gibson County); 54, 54A, 54C (Posey County); 56A (Lagrange County); 57A (Noble County); 59A (Allen County); 62A (Elkhart County); 64A (Marshall County); 65A (Fulton County); 67A (Pulaski County); 69A (LaPorte County); 70A (Porter County); 72A (Newton County); 73A (Lake County); 74A (Miami County); 75A (Wabash County); 76 and 76A (Huntington County); 77 and 77A (Wells County); 80 and 80A (Blackford County); 81 and 81A (Delaware County); 82 and 82A (Grant County); 86A (Dearborn County); 92A (Randolph County); 93A (Henry County); 94A (Hancock County); 95A (Decatur County); 97A (Rush County); and 99A (Madison County).

Checked Without Revision Petroleum Exploration Maps (as of December 31, 1984): 19A (Putnam County); 20A (Montgomery County); 27A (Orange County); 29A (Washington County); 31A (Brown County); 33A (Hendricks County); 34A (Marion County); 35A (Morgan County); 37A (Tippecanoe County); 41A (Benton County); 43A (Carroll County); 44A (Clinton County); 45A (Boone County); 47A (Jefferson County); 55A (Steuben County); 58A (DeKalb County); 60A (Whitley County); 61A (Kosciusko County); 63A (St. Joseph County); 66A (Cass County); 68A (Starke County); 71A (Jasper County); 78 and 78A (Adams County); 83A (Howard County); 84A (Switzerland County); 85A (Ohio County); 87A (Ripley County); 88A (Franklin County); 89A (Union County); 90A (Fayette County); 91A (Wayne County); 96A (Shelby County); 98A (Hamilton County); and 100A (Tipton County).

#### Miscellaneous Maps

Shaffer, N. R. (compilers: C. H. Ault, D. D. Carr, G. S. Fraser, W. A. Hasenmueller, and N. R. Shaffer), 1984, Map of Indiana showing locations of coal and industrial minerals operations: Indiana Geological Survey Miscellaneous Map 41.

### Coal Maps

Weber, L. A., 1984, Map of Vanderburgh County, Indiana, showing locations of underground coal mines: Indiana Geological Survey Coal Map 1.

Weber, L. A., 1984, Map of Warrick County, Indiana, showing locations of underground coal mines: Indiana Geological Survey Coal Map 2.

Weber, L. A., 1984, Map of Perry County Indiana, showing locations of underground coal mines: Indiana Geological Survey Coal Map 3.

Weber, L. A., 1984, Map of Gibson County, Indiana, showing locations of underground coal mines: Indiana Geological Survey Coal Map 4.

Weber, L. A., 1984, Map of Pike County, Indiana, showing locations of underground coal mines: Indiana Geological Survey Coal Map 5.

Weber, L. A., 1984, Map of Dubois County, Indiana, showing locations of underground coal mines: Indiana Geological Survey Coal Map 6.

Weber, L. A., 1985, Map of Knox County, Indiana showing locations of underground coal mines: Indiana Geological Survey Coal Map 7.

Weber, L. A., 1985, Map of Daviess County, Indiana showing locations of underground coal mines: Indiana Geological Survey Coal Map 8.

Weber, L. A., 1985, Map of Sullivan County, Indiana showing locations of underground coal mines: Indiana Geological Survey Coal Map 9.

Weber, L. A., 1985, Map of Greene County, Indiana showing locations of underground coal mines: Indiana Geological Survey Coal Map 10.

Weber, L. A., 1985, Map of Vigo County, Indiana showing locations of underground coal mines: Indiana Geological Survey Coal Map 11.

### Publications List

Woodard, G. S., 1985, Geologic publications of Indiana: 24 pages, 2 maps.

### Special Reports

Brown, G. D., Jr., and Daly, E. J., 1985, Trepostome Bryozoa from the Dillsboro Formation (Cincinnatian Series) of southeastern Indiana: Special Report 33, 95 pages, 12 plates, 1 figure, 26 tables.

### REPORTS AND MAPS SUBMITTED FOR PUBLICATION

Carpenter, G. C. and Keller, Stanley J., Oil development and production in Indiana during 1983; Mineral Economic Series.

Droste, J. B., and Shaver, R. H., Comparative stratigraphic framework for Silurian reefs--Michigan Basin to surrounding platforms: Michigan Basin Geological Society Special Paper, 24 pages, 22 figures.

Droste, J. B., and Shaver, R. H., Upper Silurian and Lower Devonian stratigraphy of the inner Illinois Basin: Indiana Geological Survey Special Report, 37 pages, 13 figures.

Ethington, R. L., Droste, J. B., and Rexroad, C. B., Conodonts from subsurface Champlainian (Ordovician) rocks of eastern Indiana: Indiana Geological Survey Special Report, 64 pages, 5 figures, 2 plates, 1 table.

Fraser, G. S., Origin of mid-channel islands in the Ohio River near Evansville, Indiana: Indiana Geological Survey Special Report, 21 pages, 12 figures.

Gray, H. H., Outline of the geology of the Louisville region: Annual Highway Geologists Symposium, Kentucky, 12 pages, 3 figures.

Keith, B. D., Map of Indiana showing structure on top of and oil productive areas of Black River Group (Ordovician); Miscellaneous Map.

Miller, B. B., McCoy, W. D., and Bleuer, N. K., Aminostratigraphy of Pleistocene Deposits in West-Central Indiana: Geology, 10 pages, 2 figures, 1 table.

Norby, R. D., and Rexroad, C. B., Vogelgnathus, a new Mississippian conodont genus: Indiana Geological Survey Occasional Paper, 36 pages, 3 plates, 3 figures, 1 table.

Rexroad, C. B., and Merrill, G. K., Conodont biostratigraphy and paleoecology of Middle Carboniferous rocks in southern Illinois: Courier Forschungsinst. Senckenberg, 21 pages, 4 plates, 5 figures.

Shaver, R. H., A case history: Silurian reefs of northeastern North America, one of the great fossil reef systems (abs.): Symposium on history of study of North American reefs, Geological Society of America, volume 17, 1 page.

Shaver, R. H., and others, Compendium of Paleozoic rock-unit stratigraphy in Indiana--A revision: Indiana Geological Survey Bulletin, 567 pages, 6 plates, 2 figures.

#### MEMORANDUM REPORTS

Ault, C. H., 1984 and 1985, numerous memorandum reports for quarries in Indiana.

Ault, C. H., February, 1985, "Coalbed interpretations from electric logs and evaluation of coal properties," Memorandum Report 135.

Ault, C. H., June, 1985, a report on the Martin Marietta underground mine in Marion County.

Badiei, Jalil, October, 1984, "Correlation and Comparison of the Lost River Chert of the Ste. Genevieve Formation in South-Central Indiana and North-Central Kentucky."

Bleuer, N. K., and Hartke, E. J., September 21, 1984, General geology of potential sites in Indiana for construction of the Superconducting Super Collider, a U.S. Department of Energy facility: 14 pages, 15 figures, 2 exhibits.

Bleuer, N. K., Fraser, G. S., Hartke, E. J., June 7, 1985, Geology of the St. Joseph River basin in Indiana: 20 pages, 5 figures, 2 tables.

Fraser, G. S., Bleuer, N. K., and Rexroad, C. B., June 28, 1985, Geology of the Whitewater River basin in Indiana: 20 pages, 7 figures, 3 tables.

Gray, H. H., June 19, 1985, Geology of three sites near Richmond, Indiana: 3 pages, 2 figures.

Gray, H. H., June 19, 1985, Geology of a site near Lafayette, Indiana: 3 pages, 2 figures.

Leibold, A. W., III, March, 1985, "Stratigraphy, petrography, and depositional environment of the Bryantsville Breccia (Meramecian) of south-central Indiana," Memorandum Report 1070.

Shaver, R. H., July 20, 1984, July 1984 Addendum to 1978-1982 reports on Wabash River flood-plain erosion half a mile north of New Harmony, Indiana: 7 pages, 2 figures.

Shaver, R. H., September 20-22, 1984, Silurian reefs and associated strata in western Ohio and northern Indiana with emphasis on size, geometry, and paleoenvironments: 53 pages, 27 figures.

Shaver, R. H., October 26, 1984, Evaluation of three Silurian reefs in northern Indiana as potential National Natural Landmarks: 21 pages, 3 figures, 5 exhibits.

Smith, C. R., June, 1985, a report on the amount of stone quarried on a litigated stone property in Brown County.

#### MISCELLANEOUS PUBLICATIONS

Ault, C. H., Harper, Denver, Smith, C. R., and Wright, M. A., 1985, Faulting and jointing in and near surface mines of southwestern Indiana: U.S. Nuclear Regulatory Commission NUREG/CR-4117, 33 pages.

Ault, C. H., and Smith, C. R., 1985, Bedrock structures and regional lithospheric stress: a predictor model in southern Indiana (abs.): Geological Society of America Abstracts with Programs, volume 17, page 278.

Bleuer, N. K., 1985, Downhole gamma-ray logging and the nature of glacial sequences (abs.), in Annual Highway Geologists Symposium Program, 2 pages.

Bleuer, N. K., and Fraser, G. S., 1985, The Michigan Lobe--Its eastern edge and related drainage: North-Central Geological Society of America Abstracts with Programs, volume 17, page 280.

Carr, D. D., and others, 1984, Report of the Membership Committee: Mining Engineering, volume 36, number 7, pages 737-738.

Carr, D. D., 1985, Indiana mineral developments in 1984: Mining Engineering, volume 37, number 5, page 405.

Coveney, R. M., Jr., and Shaffer, N. R., 1985, Sulfur isotopes related sedimentation conditions for metalliferous black shales of Pennsylvanian age (abs.): American Association of Petroleum Geologists Bulletin, volume 69, page 246.

DiMichele, W. A., Rischberter, M. O., Eggert, D. L., and Gastaldo, R. A., 1984, Stem and leaf cuticle of Karniopteris, source of cuticle from the Indiana paper coal: American Journal of Botany, volume 71, pages 626-637.

Ebbott, K. A., Krothe, N. C., and Shaffer, N. R., 1985, Hydrochemical reconnaissance study in Washington County, Indiana (abs.): Geological Society of America Abstracts with Programs, volume 17, page 286.

Fraser, G. S., 1984, Artificial beach replenishment, in Finkl, C. W., Jr., ed., Encyclopedia of applied geology: New York, Van Nostrand Reinhold Co., pages 28-31.

Fraser, G. S., and Bleuer, N. K., 1985, Drainage mechanisms of late Wisconsinan glaciers in the Lake Michigan basin: North-Central Section Geological Society of America Abstracts with Programs, volume 17, page 288.

Fraser, G. S., Larsen, C. E., and Hester, N. C., 1985, Climatic control of lake levels in the Lake Michigan and Lake Huron basins: North-Central Section Geological Society of America Abstracts with Programs, volume 17, page 288.

Gray, H. H., 1984, Archaeological sedimentology of overbank silt deposition on the floodplain of the Ohio River near Louisville, Kentucky: Journal of Archaeological Science, volume 11, number 5, pages 421-432, 5 figures.

Gray, H. H., 1985, Outline of the geology of the Louisville region (abs.), in 36th Annual Highway Geology Symposium Program, 1 page.

Harper, Denver, 1985, Geologic conditions in underground mines in the Survant and Hymera Coal Members (Middle Pennsylvanian) of Indiana, in Chugh, Y. P., ed., Proceedings Second Conference on Ground Control Problems in the Illinois Coal Basin: Carbondale, Illinois, Southern Illinois University, pages 31-38.

Hasenmueller, W. A., and Hattin, D. E., 1985, Apatitic connecting rings in molds of Baculites sp. from the Smoky Hill Member, Niobrara Chalk (Santonian), western Kansas (abs.): Geological Society of America Abstracts with Programs, volume 17, page 292.

Hill, J. R., 1985, The Geologic Story of Wyandotte Cave: Indiana Division of Forestry, 8 pages, 5 figures.

Leininger, R. K., Hasenmueller, N. R., and Shaffer, N. R., 1984, Variability of the oil shale of southeastern Indiana (abs): Abstracts of Papers, International Chemical Congress of Pacific Basin Societies, abstract number 07C18.

Lineback, J. A., Bleuer, N. K., Mickelson, D. M., Farrand, W. R., and Goldthwait, R. P., 1983, Quaternary geologic map of the Chicago 40 X 60 Quadrangle, United States, in Richmond, G. M., and Fullerton, D. S., eds., Quaternary Geologic Atlas of the United States: U.S. Geological Survey Miscellaneous Investigation Series, Map I-1420 (NK-16).

Merrill, G. K., and Rexroad, C. B., 1985, Conodont fauna of the Sellers Limestone Member (Pennsylvanian Morrowan) of southern Illinois: Southeast Section Geological Society of America Abstracts with Programs, volume 17, page 124.

Merrill, G. K., Austin, R. H., von Bitter, P. H., and Rexroad, C. B., 1985, Phylogenetic expression of genetic relationships and apparatus composition among cavusgnathoid conodonts, in Aldridge, R. L., and others, eds., Fourth European Conodont Symposium (ECOS IV) Abstracts: England, University of Southampton, 1 p.

Miller, B. B., McCoy, W. D., and Bleuer, N. K., 1985, Aminostratigraphy of Indiana Quaternary deposits: North-Central Section Geological Society of America Abstracts with Programs, volume 17, page 319.

Nelson, W. J., Eggert, D. L., DiMichele, W. A., and Stecyk, A. C., 1985, Origin of discontinuities in coal-bearing strata at Roaring Creek (basal Pennsylvanian of Indiana): International Journal of Coal Geology, volume 4, number 4, pages 355-370.

Rexroad, C. B., and Horowitz, A. S., 1984, An examination of conodont biofacies in the Beaver Bend Limestone (Chesterian, Carboniferous) in Indiana, in Clark, D. L., ed., Conodont biofacies and provincialism: Geological Society of America Special Paper 196, pages 229-231, 3 figures.

Rexroad, C. B., and Nicoll, R. S., 1985, Re-examination of Silurian conodont clusters from northern Indiana, in Fourth European Conodont Symposium (ECOS IV) Abstracts: England, University of Southampton, 1 page.

Rexroad, C. B., Shaver, R. H., and Droste, J. B., 1985, Conodonts from the Wabash Formation (Ludlovian and Pridolian Series) in northern Indiana-- Report of progress: North-Central Section Geological Society of America Abstracts with Programs, volume 17, page 323.

Shaffer, N. R., Leininger, R. K., and Ennis, M. V., 1984, Pennsylvanian shales in Indiana as potential oil shales (abs.): Fourth Eastern Oil Shale Symposium Abstracts with Programs, page 38.

Shannon, K. M., Krothe, N. C., and Shaffer, N. R., 1985, Exploration for Mississippi Valley-type ores in Lawrence County, Indiana, using groundwater chemistry (abs.): Geological Society of America Abstracts with Programs, volume 17, page 326.

Shaver, R. H., 1984, Atokan Series concepts with special reference to the Illinois Basin and Iowa, in Sutherland, P. K., and Manger, Walter, eds., The Atokan Series and its boundaries: Oklahoma Geological Survey Bulletin 136, pages 101-113, 8 figures.

Shaver, R. H., and others, 1985, Midwestern Basins and Arches Region, in Lindberg, F. A., ed., Correlation of stratigraphic units of North America (COSUNAO project): American Association of Petroleum Geologists COSUNA chart.

Shaver, R. H., Droste, J. B., and Rexroad, C. B., 1985, Cyclicity in Silurian carbonate deposition, southern Great Lakes area, in relation to models for changes in global sea level: North-Central Section Geological Society of America Abstracts with Programs, volume 17, page 326.

Gerald Carpenter prepared a summary review of oil industry activities following a request of Lynne Gannan, managing editor of the Northeast Oil Reporter.

Brian Keith submitted a manuscript titled: "Facies, diagenesis, and the upper contact of the Trenton Limestone in northern Indiana" to be included in Michigan Geological Society Special Publication 4 which will be published this summer.

Gerald Carpenter prepared a paper on oil exploration and development in Indiana for inclusion in the annual world energy issue of the Bulletin of the American Association of Petroleum Geologists.

#### REPORTS PUBLISHED IN OUTDOOR INDIANA

Hill, J. R., 1984, Icebound Giants: Outdoor Indiana, volume 49, number 6, pages 36-38.

Hill, J. R., 1984, Sentinels of stone: Outdoor Indiana, volume 49, number 10, pages 14-17.

Hill, J. R., 1984, Hounds of the hills: Outdoor Indiana, volume 50, number 5, pages 28-32.

Rexroad, C. B. and Hill, J. R., 1984, Where the falls: Outdoor Indiana, volume 49, number 8, pages 36-38.

#### PAPERS AND POSTERS PRESENTED AT PROFESSIONAL MEETINGS

Ault, C. H., and Smith, C. R., Bedrock structures and regional lithospheric stress: a predictor model in southern Indiana, Geological Society of America, De Kalb, Illinois, April 25, 1985.

Bleuer, N. K., Downhole geophysical logging of glacial sequences: 36th Annual Highway Geology Symposium, Clarksville, May 14, 1984.

Bleuer, N. K., and Fraser, G. S., The Lake Michigan Lobe--Its eastern edge and related drainage: Symposium on "Lake Michigan basin I: Sedimentation and stratigraphy of the Lake Michigan basin during the late Quaternary," North-Central Section Geological Society of America, De Kalb, Illinois, April 25, 1985.

Carr, D. D., Status of oil shale development in Indiana, Illinois-Indiana Section of American Institute of Professional Geologists, April 2, 1985.

Carr, D. D., Oil Shale potential of the New Albany Shale in Indiana, Ohio-Michigan Section of American Institute of Professional Geologists, April 26, 1985.

Coveney, R. M., Jr., and Shaffer, N. R., Sulfur isotopes related to sedimentation conditions for metalliferous black shales of Pennsylvanian age, American Association of Petroleum Geologists, New Orleans, Louisiana, March 25, 1985.

Ebbott, K. A., Krothe, N. C., and Shaffer, N. R., Hydrochemical reconnaissance study in Washington County, Indiana, Geological Society of America, De Kalb, Illinois, April 25, 1985.

Fraser, G. S., and Bleuer, N. K., Drainage mechanisms of late Wisconsinan glaciers in the Lake Michigan basin: Symposium on Glacigenic Deposystem Models, North-Central Section Geological Society of America, De Kalb, Illinois, April 25, 1985.

Fraser, G. S., Larson, C. E., and Hester, N. C., Climatic control of lake levels in the Lake Michigan and Lake Huron basins: Symposium on the Lake Michigan basin: North-Central Section Geological Society of America, DeKalb, Illinois, April 25, 1985.

Gray, H. H., Outline of the geology of the Louisville region: 36th Annual Highway Geology Symposium, Clarksville, May 13, 1985.

Gray, H. H., Geology of southern Indiana: 5th Annual Forest Soils Workshop/Conference, Jasper, October 23, 1984.

Hasenmueller, W. A., and Hattin, D. E., Apatitic connecting rings in molds of Baculites sp. from the Smoky Hill Member, Niobrara Chalk (Santonian), western Kansas, Geological Society of America, De Kalb, Illinois, April 26, 1985.

Merrill, G. K., and Rexroad, C. B., Conodont fauna of the Sellers Limestone Member (Pennsylvanian Morrowan) of southern Illinois: Southeast Section Geological Society of America, Knoxville, Tennessee, March 22, 1985.

Miller, B. B., McCoy, W. D., and Bleuer, N. K., Aminostratigraphy of Indiana Quaternary deposits: North-Central Section Geological Society of America, De Kalb, Illinois, April 26, 1985.

Rexroad, C. B., Shaver, R. H., and Droste, J. B., Conodonts from the Wabash Formation (Ludlovian and Pridolian Series) in northern Indiana--Report of progress: Symposium on the Silurian of the Great Lakes area, North-Central Section Geological Society of America, De Kalb, Illinois, April 27, 1985.

Shaffer, N. R., Leininger, R. K., and Ennis, M. V., Pennsylvanian shale in Indiana as potential oil shales, Fourth Eastern Oil Shale Symposium, Lexington, Kentucky, November 28, 1984.

Shannon, K. M., Krothe, N. C., and Shaffer, N. R., Exploration for Mississippi Valley-type ores in Lawrence County, Indiana, using groundwater chemistry, Geological Society of America, De Kalb, Illinois, April 25, 1985.

Robert Shaver, Cyclicity in Silurian reef development in the Great Lakes in relation to paleogeography and world sea levels: Sixteenth Annual Undergraduate Geology Field Conference, Green Bay, Wisconsin, September 22, 1984.

Shaver, R. H., and Droste, J. B., Comparative stratigraphic frameworks for Silurian reefs--Michigan Basin to surrounding platforms: Symposium on the Silurian and Ordovician of the Michigan Basin, University of Michigan, Ann Arbor, Michigan, February 22, 1985.

Shaver, R. H., Droste, J. B., and Rexroad, C. B., Cyclicity in Silurian carbonate deposition, southern Great Lakes area, in relation to models for changes in global sea level: Symposium on Silurian of the Great Lakes area, North-Central Section Geological Society of America, De Kalb, Illinois, April 27, 1985.

#### PROFESSIONAL ACTIVITIES AND COMMITTEES

In December 1984, Don Carr was asked to serve as a member of the American Institute of Mining and Metallurgical Engineers (AIME) Rossiter W. Raymond Memorial Award Committee. This award recognizes the best paper published by AIME written by a member under 33 years of age.

Curt Ault (Chair) and Denver Harper served on an advisory group with Lou Miller, John Hill, Stanley Keller, Carl Rexroad, and Joseph Whaley to make recommendations for the selection of the new State Geologist. They met with all members of the Survey and held meetings of the group for anyone who wished to speak to them. The recommendations of the group were presented to Messrs. Bill Andrews and James Ridenour on May 10 at Indianapolis. Written copies of the recommendations were circulated to members of the Survey.

Stan Keller completed a report to the Potential Gas Committee, of which he is a member. The report presented an estimate of the potential gas resource for each of the major geologic provinces present in Indiana -- the Illinois Basin, the Cincinnati Arch, and the Michigan Basin.

While attending the annual meeting of the American Association of Petroleum Geologists in New Orleans, Gerald Carpenter attended a workshop and committee meeting of the American Association of Petroleum Geologists (AAPG)-American Petroleum Institute (API) Committee on Statistics of Drilling. He also attended the meeting of the House of Delegates of the AAPG as a delegate representing the Indiana-Kentucky Geological Society.

Ned Bleuer prepared a news release on the project "Shuttle Imaging Radar-B" (re: continental glacial features) that is being conducted by Hilton Johnson, University of Illinois, Bleuer and Gordon Fraser, Indiana Geological Survey, and Stanley Totten, Hanover College.

Ned Bleuer and Gordon Fraser met with others from Indiana University and Purdue University to discuss organization of a Quaternary research group.

Ned Bleuer and Gordon Fraser attended a Society of Economic Paleontologists and Mineralogists short course on "Glacial Depositional Environments," held during the meeting of the North-Central Section Geological Society of America.

Gordon Fraser cochaired a Quaternary geology session of the North-Central Section Geological Society of America meeting in De Kalb, Illinois; he is also an associate editor of the Journal of Sedimentary Petrology, a publication of the Society of Economic Paleontologists and Mineralogists, and continues as the distributor for the set of "Organic Geochemistry Lecture Notes" for the Great Lakes Section, SEPM.

Henry Gray met in Indianapolis with members of the Chicago Environmental Protection Agency, a member of the Indiana State Board of Health, and other members of the Survey to discuss hydrology and the problems associated with brine disposal in the Midland Steel disposal well in Gary, August 29, 1984; he continues as a member of the Survey's Geologic Names Committee.

Edwin Hartke completed a questionnaire on the "Ohio-Indiana Carbonate and Glacial Regional Aquifer System Analysis," for the Water Resources Division, U.S. Geological Survey; he attended, with other members of the Survey, a meeting in Indianapolis with representatives of the National Cartographic Information Center to discuss the Survey's participation in their program as a state center for cartographic information, September 26, 1984; he attended the Acid Rain Symposium, sponsored by the School of Public and Environmental Affairs and the Department of Biology at Indiana University, April 18-19, 1985, and he continued to serve as illustrations editor of all maps and reports of the Geological Survey.

Carl Rexroad was elected Chief Panderer of the Pander Society, an international professional society for conodont workers, for the years 1985-1990 and chaired business meeting of that organization in Knoxville, Tennessee.

Robert Shaver served as chairman of the Survey's Geologic Names Committee; he was elected to Honorary Membership in the Society of Economic Paleontologists and Mineralogists; he attended three meetings of Tri-State Superconducting Super Collider Site Study Committee, the SSC being a U.S. Department of Energy facility, and he attended the Central Region Cluster Meeting, State Geological Surveys/U.S. Geological Survey, in St. Louis.

#### PUBLIC LECTURES

Sam Frushour gave a talk on karst features, caves, and cave photography, Boy Scout Group, Fairview Methodist Church, Bloomington, September 19, 1984.

Robert Shaver gave a talk on cyclicity in Silurian reef development, in world sea levels, and in the minds of men, Indiana University Department of Geology Colloquium, September 24, 1984.

On October 10, Don Carr gave a colloquium talk at Indiana State University in Terre Haute on "Oil shale resources in Indiana."

On October 23, Don Carr gave a colloquium talk at Indiana University-Purdue University at Indianapolis on "Energy resource potential of the New Albany Shale."

Gordon Fraser spoke on industrial uses of glacial deposits to an Indiana University earth science class on October 24, 1984.

On October 24 and 25, Curt Ault gave two presentations on cementing depths to protect coals in southwestern Indiana at two hearings conducted by the Department of Natural Resources.

Chris Smith gave two guest lectures to Noel Krothe's Indiana University hydrology class on November 6 and 8.

Gordon Fraser reviewed Delta-margin processes, University of Kentucky sedimentation class, November 15, 1985.

Gordon Fraser gave a talk on shelf hydraulics and their application to sedimentation in Epeiric Seas at the University of Kentucky Department of Geology Colloquium, November 16, 1984.

Brian Keith presented a talk to the Indiana University-Purdue University at Indianapolis Geology Department Colloquium on November 20. Title of his talk was "History and Geology of the Trenton Field".

Curt Ault gave a lecture November 29 on the "Coal resources of Posey County" to more than 100 farmers and businessmen at Mt. Vernon, Posey County.

Nelson Shaffer gave a talk on Pennsylvanian oil shales to an Indiana University geochemistry seminar on January 17.

On January 22, all members of the Coal and Industrial Minerals Section gave presentations at the annual review of Section projects.

Nelson Shaffer gave a public lecture about meteorites February 1 at the Geology Department at Indiana University-Purdue University at Ft. Wayne.

Brian prepared a talk titled "Facies and diagenesis of the Trenton in northern Indiana and consideration of its upper surface". The paper was presented at a symposium on the Silurian and Ordovician of the Michigan Basin and surrounding areas held at Ann Arbor, Michigan, February 22-23.

Robert Shaver spoke on the ages of Silurian reefs--or why should anyone be asked to talk on old-fashioned paleontology and stratigraphy at a symposium on the Michigan Basin?, Indiana University Paleobiology Brown Bag Seminar, February 27, 1985.

Carl Rexroad reported on middle Ordovician AWACS and other conodont taxa in the east-central Indiana subsurface at the Indiana University Paleobiology Brown Bag Seminar, February 27, 1985.

Nelson Shaffer also lectured on hydrogeochemical exploration in the Indiana University Geology G690 class February 20 and lectured on sulfur isotopes in uranium deposits to the G551 class February 28.

Gordon Fraser spoke on interlobate drainageways in the Pleistocene in Indiana, Illinois Geological Survey Seminar, Champaign, March 15, 1985.

Nelson Shaffer gave lectures to an Indiana University economic geology class on March 25, 27, and 29.

Curt Ault gave a short presentation concerning cementing depths for coal to a meeting of the Natural Resources Commission March 29 at the Indiana State Museum.

Brian Keith prepared a talk and an abstract for a meeting of the Illinois-Indiana section of the American Institute of Professional Geologists in Vincennes of April 2. The title of Brian's talk was "Trenton Limestone - Regional Setting and Petroleum". Brian also presented the talk at a meeting of the Illinois Geological Society in Olney on April 24.

Gerald Carpenter attended the Annual meeting of the Eastern Oil and Gas Equipment Show in Evansville of June 5 and 6 and presented a talk on recent oil and gas exploration and development in Indiana and some projections for anticipated future activity by the industry.

Nelson Shaffer gave a talk about hydrochemical exploration in the Mitchell Plain, southern Indiana, at a meeting of the Indiana Water Resources Association on June 6.

Robert Shaver reviewed the cyclicity of Silurian carbonate deposition, North American craton, in relation to clastic deposition on continental margins and to changes in global sea level: Shell Oil Company geologists, Marion, Indiana, June 17, 1985.

John Rupp gave an invited talk on "Careers in the Geosciences" to the undergraduate Geoscience Survey Class at Purdue University.

Brian Keith presented a talk titled "Depositional facies and diagenetic history of the Trenton Limestone in Northern Indiana" at the annual meeting of the Eastern Section of the American Association of Petroleum Geologists in Pittsburgh. Brian convened and acted as chairman for a symposium on the Trenton of eastern North America held at the convention. Papers presented at the symposium are to be assimilated into a volume and published by the AAPG as a Special Studies volume.

John Rupp presented a talk to District V, Environmental Protection Agency headquarters in Chicago on the history of the petroleum industry in Indiana with an emphasis on the history and status of fluid injection associated with petroleum production.

Gerald Carpenter gave a talk on the availability of a machine readable data base at the Indiana Geological Survey while attending the annual meeting of the Kentucky Oil and Gas Association in Lexington, Kentucky.

#### ATTENDANCE AT PROFESSIONAL MEETINGS

On July 9, Don Carr attended a meeting of the Coal Study Committee of the Energy Development Board.

Gerald Carpenter attended a meeting called by Robert Hilton, Regional Director of Region V of the Environmental Protection Agency to explain new federal regulations governing underground injection of fluids. The meeting, attended by petroleum producers in Indiana, was held in Evansville on July 19. Federal requirements for underground injection became effective in Indiana June 22, 1984.

On August 20, Don Carr, Dick Leininger, and John Patton attended a meeting of the Energy Development Board.

Nelson Shaffer attended the 500 Earth Sciences Mineral Club show on September 9 and a mineral show at Anderson September 22.

Dan Sullivan attended the opening fall meeting of the Indiana-Kentucky Geological Society in Evansville on September 19.

Robert Shaver attended the 16th Annual Undergraduate Geology Field Conference in Green Bay, Wisconsin, Sept. 21-22, 1984.

Dan Sullivan, Stan Keller, and Gerald Carpenter attended the October meeting of the Indiana-Kentucky Geological Society in Evansville. Beverly Seyler, Illinois Geological Survey, spoke on "Depositional Facies of the Aux Vases Sandstone".

On October 2, Curt Ault attended a meeting of the Tri-State Committee on Correlation in the Pennsylvanian System of the Illinois Basin at Champaign, Illinois.

On October 16, Don Carr attended an Illinois-Indiana Section-American Institute of Professional Geologists meeting in Springfield, Illinois.

On October 22, Don Carr attended the fall meeting of the Indiana Limestone Institute of America.

On October 29 and 30, Nancy Hasenmueller attended a management seminar sponsored by Indiana University.

Brian Keith, John Rupp, Dan Sullivan, and Stan Keller attended the November meeting of the Indiana-Kentucky Geological Society in Evansville. Speaker of the evening was American Association of Professional Geologists Distinguished lecturer Robert Weimer who spoke on "Depositional Models, Intrabasin Tectonics, and Sea Level Changes in Petroleum Exploration".

Paul Irwin, Licia Weber, and Lou Miller attended the annual training session of the Division of Reclamation at Trafalgar on November 1.

Curt Ault attended an Indiana University training course on use of computers in offices on November 7.

On November 2-8, Don Carr, Nelson Shaffer, and Chris Schubert attended the Geological Society of America annual meeting in Reno, Nevada.

On November 19, Don Carr attended a meeting of the Energy Development Board in Indianapolis.

On November 15, Don Carr attended a meeting of the Waste By-Products Committee of the Corporation for Science and Technology.

On November 15, Nelson Shaffer attended a meeting of the Indiana Water Resources Association at Bloomington.

Nelson Shaffer and Dick Leininger attended the Eastern Oil Shale Symposium on November 26-28 at Lexington, Kentucky.

On December 18, Don Carr and John Patton attended a meeting sponsored by MERCO on the status of oil-shale development in southeastern Indiana.

Dick Leininger attended a meeting of the International Chemical Congress of Pacific Basin Societies at Honolulu, Hawaii, December 16-21, where he presented the paper by himself, Nancy Hasenmueller, and Nelson Shaffer.

On January 14, Don Carr attended a meeting of the American Chemical Society at Indianapolis.

On January 22, geologists of the Coal and Industrial Minerals Section gave presentations at their annual review meeting at the Survey. Mr. George Land, AMAX Coal Company, was the invited guest speaker.

On January 29, Don Carr attended a meeting of the Coal Study Committee, Energy Development Board, at Indianapolis.

John Rupp, Stan Keller, and G. Carpenter attended the February meeting of the Indiana-Kentucky Geological Society in Evansville. John Beard of the Kentucky Geological Survey spoke on "Top of the Ste. Gen."

On February 18, Don Carr attended a meeting of the Energy Development Board with John Patton and Dick Leininger.

Robert Shaver attended a symposium on lower and middle Paleozoic geology of the Michigan Basin in Ann Arbor, Michigan, Feb. 21-23, 1985.

On March 1, Don Carr attended a symposium on use of industrial-waste byproducts sponsored by the Industrial Waste Byproducts Committee of the Corporation for Science and Technology.

Carl Rexroad attended the Southeast Section Geological Society of America meeting and the Pander Society meeting at Knoxville, Tennessee, March 20-24, 1985.

Walt Hasenmueller, Paul Irwin, and Licia Weber attended the Indiana Coal Mine Institute in Evansville March 27-30.

Dan Sullivan, Brian Keith, and John Rupp attended the April meeting of the Indiana-Kentucky Geological Society in Evansville. Earl Kaufman, University of Colorado, spoke on global Cretaceous sedimentation.

On April 8-11, Don Carr attended a "Symposium on coal quality," which was held at the U. S. Geological Survey National Center, Reston, Virginia.

Nelson Shaffer attended a management training seminar at Indiana University April 8-9, a meeting of Sigma Xi at IU April 3, and the IU research exposition April 18.

Curt Ault attended the Forum on Geology of Industrial Minerals held April 9-12 at Tucson, Arizona.

On April 13, Nelson Shaffer attended a gem and mineral show at Cincinnati. He attended another show at Columbus, Ohio, April 27.

Chris Smith attended a short course on glacial sedimentology April 19-20 at De Kalb, Illinois.

On April 22, Don Carr attended the annual meeting of the Indiana Limestone Institute of America, which was held at Four Winds near Lake Monroe.

On April 24-26, Curt Ault, Nelson Shaffer, Chris Smith, and Walt Hasenmueller attended the North-Central Section meeting of the Geological Society of America at De Kalb, Illinois.

Ned Bleuer, Gordon Fraser, and Robert Shaver attended the North-Central Section Geological Society of America meeting in De Kalb, Illinois, April 25-28, 1985.

Brian Keith, G. Carpenter, and John Rupp attended the May meeting of the Indiana-Kentucky Geological Society in Evansville. Wayne Pryor of the University of Cincinnati was the speaker on porosity patterns of the Illinois Basin.

Ned Bleuer and Henry Gray attended the 36th Annual Highway Geology Symposium, Clarksville, Indiana, May 13-15, 1985.

Ned Bleuer attended a field conference of Midwest Friends of the Pleistocene, Rockford, Illinois, May 17-19, 1985.

Denver Harper attended the Second Conference on Ground Control Problems in the Illinois Basin at Southern Illinois University, Carbondale, Illinois, May 29-31.

On May 30, Don Carr attended a meeting of the Energy Development Board in Indianapolis.

On May 10, Curt Ault, John Hill, and Carl Rexroad met with Bill Andrews to report on the recommendations of the Survey Advisory Group for the position of the State Geologist.

Nelson Shaffer attended a meeting of the Indiana Water Resources Association June 6 and 7.

On June 21, Don Carr attended a meeting of the Industrial Byproducts Committee at Indianapolis.

Brian Keith, Dan Sullivan, and Stan Keller attended the annual meeting of the Eastern Section of the American Association of Petroleum Geologists in Pittsburgh.

Gerald Carpenter attended a two-day formal hearing conducted by the Department of Natural Resources in Princeton, Indiana concerning rules changes proposed for test hole drilling and for protection of potentially commercial coal seams. The hearing was conducted by Steve Lucas, legal counsel for the DNR.

Stan Keller and Gerald Carpenter attended the fall meeting of the Indiana Oil and Gas Association in Evansville. Gerald spoke briefly on oil industry activities in Indiana during 1984.

Gerald Carpenter and John Rupp attended a meeting with representatives of the federal Environmental Protection Agency, Region V and the Indiana Board of Health in Indianapolis to discuss some problems associated with industrial waste disposal at the Midwest Steel well in Porter County. Concern was expressed over possible failure of the down-hole completion system as well as adequacy of the Eau Claire Formation to function as an aquetard.

Gerald Carpenter, Stanley Keller, and Dan Sullivan attended the annual meeting of the American Association of Professional Geologists in New Orleans.

John Rupp and Gerald Carpenter attended the annual meeting of the Kentucky Oil and Gas Association in Lexington, Kentucky. John presented a poster session on Harrodsburg oil production in Spencer County.

#### FIELD TRIPS

In July, Don Carr and John Patton spent a day in the field with Scott Sanders and Jeff Wolin, Indiana University professors who are writing a book on the dimension-stone industry of the Bloomington-Bedford area.

In August, Nelson Shaffer took Jeremy Dunning to a sample-collecting site at Bloomington Crushed Stone, Monroe County, and Don Eggert showed Bill DiMichele sites for field work at the Lynnville, Wabash, and Solar Sources Mines.

Nelson Shaffer took Pat Wiram and Eric Adidas of AMAX Coal Company to visit the Gemini Resources oil-shale plant on September 14.

On September 17-19, Curt Ault, Nancy Hasenmueller, Don Eggert, and Denver Harper attended a field trip to examine Pennsylvanian rocks exposed in high roadcuts near Hazard, Kentucky.

Gordon Fraser conducted a field trip on "Fluvial sedimentology of the Mansfield Formation," to the Shoals area for an Indiana University graduate sedimentation course, October 6, 1984.

Don Eggert led graduate students of Aureal Cross and Tom Phillips to sample Pennsylvanian rocks on October 13, 14, and 21.

On October 19, Nancy Hasenmueller, Don Eggert, Denver Harper, Nelson Shaffer, and Carl Rexroad attended a field trip to Solar Sources Pit #14.

In October, Chris Smith took a School of Public and Environmental Affairs class to the Blackhawk reclamation site.

Don Carr and Chris Schubert attended the Coal Geology Division field trip of Geological Society of America near Raton, New Mexico, on November 12.

Six days of field trips were led by Don Carr, Curt Ault, Don Eggert, Chris Smith, Nelson Shaffer, and Paul Irwin to examine Indiana mineral operations with Hugh Elliston and Larry Henry, geologists from the Jamaican Geological Survey from April 11 through April 18.

Curt Ault attended two field trips on April 9 and 11 to visit mineral industry operations in Arizona at the Forum on Geology of Industry Minerals.

Ned Bleuer and Gordon Fraser conducted a field trip in St. Joseph County for personnel of the Division of Water, Indiana Department of Natural Resources, on "Glacial geology of St. Joseph County," April 18-19, 1985.

Nelson Shaffer showed geode sites to Robert Maliva, Harvard University on April 30.

Curt Ault showed several of the outcrops of the West Franklin Limestone Member to Lew Brown and two other faculty members from Lake Superior State College in May.

In May, Chris Smith attended a field trip and short course sponsored by the SOHIO company to observe recent geologic features in California. The trip was led by Gordon Fraser.

On June 7, Nelson Shaffer attended a field trip for the Indiana Water Resources Association.

Robert Shaver led a two-day field trip on "Silurian reefs and stratigraphy, western Ohio to northwestern Indiana," for Shell Oil Company geologists, June 17-18, 1985.

In June, Nelson Shaffer took a group of high school students gold panning.

Brian Keith accompanied Robert Shaver who conducted a group of Shell Oil Company geologists on a tour of reef exposures of northern Indiana.

## REVIEWS

On July 5, Don Carr reviewed a proposal for the Energy Development Board on "Limestone injection multistage burner (LIMB) demonstration project."

On July 24, Don Carr reviewed a proposal on "KILnGAS commercial module operating project."

On February 22, Don Carr reviewed a paper on "The evaporite deposits of Laguna Del Rey," for the Society of Mining Engineers.

In February, Nancy Hasenmueller reviewed a manuscript on the Survant and Hymera Coal Members for the Geologic Names Committee.

In March, Nancy Hasenmueller critically reviewed a manuscript, "Comparative stratigraphic framework for Silurian reefs--Michigan Basin to surrounding platforms," by John Droste and Robert Shaver. Curt reviewed the paper for geologic names.

In March, Nancy Hasenmueller critically reviewed Denver's revised manuscript on coal mining in Sullivan County.

In March, Denver Harper reviewed a paper by Dana Meier for a ground-control conference.

On April 4, Don Carr and Nelson Shaffer reviewed a paper on "Relationship of geologic setting and kaolin characteristics to filler applications" for the Society of Mining Engineers.

In April, Nelson Shaffer reviewed a paper by Miller, McCoy, and Bleuer on "Aminostratigraphy of Pre-Wisconsinian Pleistocene deposits."

On April 23, Don Carr reviewed a proposal on a "Furnace Sorbent injection demonstration project" for the Coal Study Committee of the Energy Development Board.

In April, Nancy Hasenmueller and Curt Ault reviewed a manuscript by Shaver and Droste on Illinois Basin stratigraphy for use of geologic names.

On April 24, Don Carr reviewed a paper on "The Wing Hill garnet deposit of Rangely, Maine, and its relationship to world markets."

John Rupp and Dan Sullivan reviewed a preliminary copy of a map of the structural position of the basement rocks in Illinois (and extreme southwest Indiana) for Mike Sargent and Tom Buschbach. The map will be published by the Illinois Geological Survey.

Dan Sullivan acted as critical reader for the paper prepared by Curtis Ault as the final report on the Nuclear Regulatory Commission study concerning the effects of the New Madrid fault.

Dan Sullivan critically read a manuscript prepared by Joe Hailer on "Analysis of Ground Water in Indiana". Another manuscript prepared by Joe Hailer on applications of geochemical studies to the Trenton Limestone in Indiana was reviewed by Brian Keith.

Gerald Carpenter reviewed a paper by Nelson Shaffer, Richard Leininger and Margaret Ennis titled "Oil Shales of Pennsylvanian Age in Indiana".

Stanley Keller and Gerald Carpenter conferred with Karen Halstead of the Indiana Petroleum Council and edited a manuscript she has prepared for distribution by the Council. The manuscript titled "Oil in Indiana, 1984-1985" was prepared to update information presented in the Survey's Bulletin 42-N and to present a more generalized view of industry including refining, marketing, etc. Karen has made copies available to the Survey for free distribution.

Stan Keller critically read a manuscript by Denver Harper entitled "Geologic conditions in underground mines in the Survant and Hymera coal members of Indiana".

John Rupp critically read a manuscript prepared by John Droste and Robert Shaver on the Upper Silurian and Lower Devonian rocks of the Illinois Basin.

At the request of the editor of the periodical "Northeastern Geology", Brian Keith reviewed an article titled "Devonian Oriskany reservoir and trap in Coshocton County, Ohio."

Ned Bleuer reviewed the following: a paper by a member of ATEC, Associates, on till stratigraphy; papers on till fabrics and drainage orientation by two DePauw University students; a Geological Society of Canada Special Paper on Quaternary evolution of the Great Lakes; and papers on early glaciology by faculty members from Bowling Green University, University of Wisconsin, and University of Wisconsin Parkside.

Gordon Fraser critically reviewed the following: an Indiana University doctoral thesis on the Kootenai Formation of the northern Rockies; a master's thesis on the Mansfield Formation of Indiana; three manuscripts for the Journal of Sedimentary Petrology; a Geological Society of America manuscript on causes of variations in thickness of coal seams; an abstract for North-Central Section Geological Society of America Abstracts with Programs, volume 17; an Indiana University thesis on glacial deposits of the Deer Creek drainage system; and two master's theses for Indiana University geology students.

Gordon Fraser, Carl Rexroad, and Robert Shaver each reviewed for possible publication by the Survey a report by an Indiana University geology graduate student and others on a Paleozoic carbonate erosion surface in Indiana.

Henry Gray critically read the following: a manuscript on "Oil shale prospects of the New Albany Shale in Indiana"; a manuscript on geology of the Whitewater River basin for the Department of Natural Resources; two Indiana University geology theses and a liminology thesis as a member of the student thesis committees; a manuscript to be published in the Indiana Academy of Science Proceedings on "Natural Regions of Indiana"; a manuscript on conodont biostratigraphy of the Mississippian-Pennsylvanian boundary in the Illinois

Basin; two abstracts to be published in the North-Central Section Geological Society of America Abstracts with Programs, volume 17; and a manuscript for the editor of Journal of Archaeological Sciences.

Edwin Hartke critically reviewed a manuscript for the Journal of Hydrology on "Use of dye tracers in an abandoned underground coal mine," and (with John Hill) reviewed two Environmental Protection Agency proposals for groundwater monitoring at two sites, one near Seymour and the other at Lake Sandy Jo near Gary, for the State Board of Health.

Carl Rexroad reviewed the following: a paper on conodonts and stratigraphy in Carabou Gold Belt, east-central British Columbia" for the Canadian Journal of Earth Sciences; manuscript copy for Cambrian and Ordovician articles for the revised Compendium; a manuscript on the use of conodonts by a New York high school student for submission in a Westinghouse competition; a manuscript on the conodonts of the Windsor Group, Quebec, Canada; a manuscript on faunistic and lithologic evidence for Wenlock and Ludlow oceanic conditions, at the request of the author; a thesis on petrology of Vienna Limestone by an Indiana University student; and a paper for the Ohio Journal of Science on chitinozoa from eastern Cincinnati region.

Robert Shaver critically read the following: an outside manuscript for publication as an Occasional Paper; a master's thesis for a University of Oklahoma student; an Outdoor Indiana article on fossilizing; a newsletter article on the Trenton Limestone; a Cambro-Ordovician chart for the U.S. Geological Survey; an abstract on conodonts for the Southeast Section Geological Society of America; a manuscript by an English geologist on 19th Century fossil collections near Hamilton, Ontario; a report for the Department of Energy on oil shales of Pennsylvanian age in Indiana; three abstracts for the North-Central Section Geological Society America; abstract for publication in European Conodont Symposium IV; a postcard map of bedrock geology of Indiana; Compendium articles for the Cambro-Ordovician section up through the Black River Group; a chapter on Salem building stone in an Indiana University Press book on limestone; a chapter on epeiric seas for a book on sedimentology; and an article for Outdoor Indiana on Indiana waterfalls.

#### NEWS RELEASES

In September, Nelson Shaffer, Curt Ault, Don Carr, Gordon Fraser, and Walt Hasenmueller prepared a news release announcing the availability of the new Coal Map series. The release will be handled through the Division of Reclamation.

John Rupp wrote two requested articles for inclusion in the annual "Oil Progress Edition" of the Evansville Sunday Courier and Press. One article outlined the recent level of petroleum activity in the state and the other explained the activities and functions of the Petroleum Section of the Survey.

#### MISCELLANEOUS ACTIVITY

Paul Irwin, Don Eggert, and Lou Miller testified on the character of coal tailings at a hearing of the Division of Reclamation and Dale Bland, September 11 and 21 in Jasonville.

Paul Irwin gave a tour of the core library and the sample preparation facilities to a group of Webelos Cub scouts in November.

Nelson Shaffer received a pin for 10 years of service at the Survey in January.

Curt Ault, Nelson Shaffer, and Joe Hailer wrote a critique of a proposed constitution for an Indiana University staff council for professionals.

Curt Ault appeared as an expert witness at an Mine Safety and Health Administration hearing in Evansville February 14 and 15 to testify concerning the presence of joints near Peabody's Lynville Mine.

Don Eggert received an award from the American Red Cross April 8 for the most number of Cardio-Pulmonary Resuscitation courses taught.

Members of the Coal and Industrial Minerals Section spent several days during the week of June 17-21 helping William Bonin, U.S. Bureau of Mines, become acquainted with Indiana's mineral industry.

Brian Keith prepared some copies of geophysical logs with correlations recognized by the Indiana Survey for Larry Wickstrom of the Ohio Geological Survey. Wickstrom is preparing a study of the Trenton Limestone of Ohio and had requested data on several counties in Indiana adjacent to Ohio. It is hoped that an exchange of information between Brian and Wickstrom can be mutually beneficial in preparation of the studies of the Trenton.

Members of the Petroleum Section met with other members of the Geological Survey to discuss regional subsurface geology of the Illinois Basin with Gerald Salisbury, Union Oil Company.

Dan Sullivan, Stan Keller, John Rupp, and Gerald Carpenter attended the annual picnic of the Independent Oil Producers Association in Mt. Vernon, Indiana.

Gerald Carpenter was interviewed by a reporter from the Bloomington newspaper, Herald Telephone, concerning an article written about the oil industry in Indiana.

Brian Keith was part of a group meeting to establish standards for uniform logging by the Geological Survey in order that geophysical logs run by the Survey would be more compatible with commercial logs. Also, plans were formulated to digitize logs formerly run which do not match commercial logs in order that a uniform scale for all logs can be obtained. An additional benefit to be derived from digitizing the logs is the capability of creating logs to any desired scale to meet the needs of an investigator on a particular problem.

The Petroleum Section received a request from the Division of Oil and Gas for a determination of the number of wells per county in Indiana which are currently "active" (i.e., those which are currently productive or are supportive of production). The initial request was followed by another which sought the number involved in underground injection of fluids which are currently in some state of utility. Both requests were prompted by directives

from the office of the Director of the Department of Natural Resources for considerations involving budgetary needs should Indiana assume primacy in administering the Environmental Protection Agency regulations relative to the underground injection of fluids in Indiana.

John Rupp and Stan Keller completed preparation of two cross sections which demonstrate the stratigraphic relationships of the St. Louis, Salem, and Harrodsburg Limestones in the eastern half of Spencer County, Indiana. Also shown in the sections are the positions of the oil productive intervals in the Harrodsburg and correlations of the three limestone units. Although the cross sections were not prepared for publication, Bruning prints are being made publicly available because of the current interest and activity in Spencer County in this part of the stratigraphic section.

STATISTICAL SUMMARY

	Total
Projects in progress . . . . .	43
Projects completed . . . . .	11
Conferences with visitors to the Survey. . . . .	769
Telephone conferences. . . . .	661
Man days of field work . . . . .	671
Incoming letters . . . . .	5,548
Outgoing letters . . . . .	3,963
Thickness of stratigraphic sections measures (ft.) . . . . .	1,466
Public lectures. . . . .	49
Papers and posters presented at professional meetings. . . . .	19
Papers reviewed. . . . .	12
Field trips (Total). . . . .	88
In connection with conferences. . . . .	61
Educational . . . . .	24
Industrial. . . . .	1
State Agency. . . . .	1
News releases. . . . .	1
Attendance at professional meetings. . . . .	27
Samples received or collected (Total). . . . .	2,236
Clay and shale samples. . . . .	365
Rocks, minerals . . . . .	733
Sand and gravel . . . . .	83
Coal samples. . . . .	3
Water samples . . . . .	817
Gob . . . . .	13

Fossils . . . . .	222
Mineralogic analyses . . . . .	77
X-ray mineralogic analysis . . . . .	623
Moisture analyses. . . . .	24
Mass spectrometer analyses . . . . .	225
Water analyses . . . . .	187
Physical tests. . . . .	68
Pump tests . . . . .	52
Brightness measurements on limestone and dolomite. . . . .	5
Core described (ft.) . . . . .	1,804
Area mapped (sq. mi.). . . . .	320
Joint orientation measurements . . . . .	312
Total number of Survey vehicles. . . . .	23
Total number of miles traveled in Survey vehicles. . . . .	166,429
Special rock sets prepared for teachers, et al . . . . .	36
Identification of specimens (rock, mineral, and fossil). . . . .	66
Information packets mailed . . . . .	93
Exhibits installed for special occasions, etc. . . . .	1
Reports completed and sent to editors for outside publication. . . . .	5
Rock analyses (magnetic, mineralogical, textural, physical). . . . .	2,752
Number of holes gamma-ray logged . . . . .	40
Feet of cores gamma-ray logged . . . . .	10,019
Number of holes augered. . . . .	37
Feet of holes augered. . . . .	1,694
Photomicrographs made. . . . .	67
Photograph prints made . . . . .	67
Environmental questionnaires . . . . .	196
Memorandum reports . . . . .	8

Visitors . . . . .	574
Visitor Days . . . . .	1,428
Talks at technical programs. . . . .	10
Well cutting sets catalogued and filed . . . . .	203
Cores (wells). . . . .	23
Strip logs made (wells). . . . .	210
Feet of well cuttings represented on strips. . . . .	308,013
Wells field checked (current drilling only). . . . .	1,321
Reproduction-Logs. . . . .	\$21,567.00
Reproduction-Xerox . . . . .	.\$3,306.20
Published reports	
Directories . . . . .	2
Mineral Economics Series. . . . .	1
Occasional Papers . . . . .	7
Special Reports . . . . .	1
Published maps	
Coal Maps . . . . .	11
Miscellaneous Maps (new). . . . .	2
Miscellaneous Maps (reprinted). . . . .	1
Petroleum Exploration Maps (new). . . . .	2
Petroleum Exploration Maps (revised). . . . .	92
Petroleum Exploration Maps (checked without revision) . . . . .	35
Publications lists issued (new). . . . .	1
Published reports sold . . . . .	6,943
Published maps sold. . . . .	13,356
Publications office customers. . . . .	5,055
Publications announcements mailed. . . . .	892

Survey reports edited. . . . .	9
Outside publications edited. . . . .	40
News releases, newsletters, exhibits, etc., edited . . . . .	15
Camera copy projects prepared. . . . .	15

	1983		1984	
	<u>Quantity</u>	<u>Value</u>	<u>Quantity</u>	<u>Value</u>
Coal	32,407,957 tons	\$795,939,424.00	36,055,649 tons	\$900,670,112.00
Petroleum	5,319,578 bbls	157,565,900.00	5,394,147 bbls	153,247,716.00
Limestone, crushed	24,026,270 tons	79,970,743.00	26,854,960 tons	89,191,176.00
Sand and Gravel	14,308,099 tons	40,665,039.00	15,080,441 tons	44,363,818.00
Limestone, dimension	2,095,384 cu.ft.	7,269,066.00	2,065,444 cu.ft.	8,236,384.00
Clay and Shale	557,998 tons	1,237,149.00	682,171 tons	1,723,047.00
Natural Gas	135,318,000 cu.ft.	282,815.00	394,416,000 cu.ft.	1,332,000.00
Undistributed (includes dimension sandstone [1983 only], gypsum, marl, peat, whetstones)		<u>9,071,341.00</u>		<u>8,643,164.00</u>
TOTAL		\$1,092,001,477.00		\$1,207,407,417.00
Value added for additional processing of dimension limestone, and manufacture of clay products and cement		\$ 104,484,639.00		\$ 140,817,875.00