

**ONE HUNDRED AND TENTH ANNUAL REPORT OF THE
STATE GEOLOGIST**

of the

**Indiana Geological Survey
Department of Natural Resources**

July 1, 1985 to June 30, 1986

STATE GEOLOGIST

Administrative Personnel

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

Orientation and General Activities

The State Geologist serves both as director of activities for the Geological Survey and as principal representative of the organization to industry, government, and the private sector. The charge of the Geological Survey has historically been to study the geology of the state for the benefit of its citizens. Through a combination of pure and applied research and public-service programs, men and women of the Survey continue to open new avenues of service for the benefit of Indiana taxpayers.

Publications

Patton, J. B., 1986, Construction materials: dimension stone, in Encyclopedia of Materials Science and Engineering, Pergamon Press, p. 820-825.

Professional Activities

Organization and Committee Activity

Served as representative of the Director of the Department of Natural Resources on the Indiana Energy Development Board.

Participated, with representatives of the U.S. Geological Survey, Illinois State Geological Survey, Kentucky Geological Survey, and Missouri Geological Survey, in meetings in St. Louis (August 15, 1985) and Springfield (October 12-13, 1985), Mo., regarding the USGS-State geological survey cooperative activity named Conterminous United States Minerals Assessment Program (CUSMAP). The Indiana involvement concerned the Paducah 1° X 2° Quadrangle, which includes small areas in Indiana along the lower Wabash River valley in Posey County.

Was chairman of the Department of Natural Resources review panel administering the program for certification of professional geologists in Indiana.

Was recipient of the 1985 Distinguished Member Award at the annual meeting of the Society of Mining Engineers, held October 16-18, 1985, in Albuquerque.

Served on the advisory Committee to the Indiana University Press/Department of Natural Resources for planning a proposed volume on natural areas and natural features in Indiana.

Ed Ripley. . . . .	.Research Assistant (May 18, 1986 to June 28, 1986)
Steven Schunk (OSM). . . . .	.Laboratory Assistant (October 6, 1985 to October 19, 1985)
Carolyn Scott. . . . .	.Laboratory Assistant (September 22, 1985 to May 3, 1986)
Randall Sippel (USGS). . . . .	.Laboratory Assistant (July 1, 1985 to July 13, 1985)
Mike Sowder (OSM). . . . .	.Laboratory Assistant (July 1, 1985 to June 30, 1986)
Eugene Spicer. . . . .	.Laboratory Assistant (August 25, 1985 to April 5, 1986)
Eric Wilkinson . . . . .	.Laboratory Assistant (August 25, 1985 to June 14, 1986)

Orientation and General Activities

Members of the section answered 1,018 requests for information during the year, about the same as in the previous year. Geologists of the section conducted research on 35 projects dealing with many aspects of the geology of the state, but they mainly directed their investigations toward the coal and industrial mineral resources of the state. Of particular interest were the completion of reports on the coal resources of two counties in southwestern Indiana and the completion of coal maps for two other counties. Section geologists continued to issue maps showing underground mines in counties in southwestern Indiana and answered requests for 370 copies of maps showing active and abandoned surface and underground coal mines. Several reports dealing with the geology and history of the Indiana Dunes were completed and submitted for publication, and research was begun on the sand and gravel resources of two counties in northern Indiana.

Although the depressed price of petroleum dampened the prospects for commercial development of oil-shale resources in Indiana, the state has one experimental program to determine the suitability of an in situ process to recover hydrocarbons from the New Albany Shale. This is the only non-laboratory oil-shale project currently funded by the U.S. Department of Energy in the United States. We continued to conduct investigations and completed reports on several aspects of the stratigraphy, structure, organic content, and geophysical characteristics of the New Albany Shale and the black shales overlying coals of Pennsylvanian age. The results of this research will be of great value in future evaluations of this extensive Indiana resource for synthetic oil.

As in past years, we received many requests for information on limestone and dolomite, clay, and sand and gravel resources of the state, including brightness measurements on limestones that could be used for fillers or whiting, thickness of limestone and dolomite reserves beneath active quarries, and the possibilities for additional reserves of sand and gravel. We continued to answer numerous requests from individual landowners on the possibilities for minerals on their property and from mineral producers on the quality and extent of reserves near active mines.

Of particular interest this year was the completion of the \$6.2 million ceramic-tile plant at Bloomfield. The Taiwanese company, KPT, Inc., built the

plant to use Indiana raw materials. The Survey aided the company in the search for these materials in southern Indiana.

Geologists of the section kept abreast of professional developments and contributed to the advancement of the profession by publication of 27 maps, abstracts, and papers concerning Survey research and by presentation of posters and oral papers at five local and national conferences.

Completed Projects or Major Parts of Projects

Cause and effect of jointing in quarries in central and northern Indiana
Report on oil yields of weathered New Albany Shale
Several aspects of the stratigraphy, structure, organic content, and geophysical characteristics of the New Albany Shale
Coal resources of Gibson County
Report published on the coal resources of Vigo County
Coal resources of Sullivan County
Geologic and mining conditions in the Survant Coal Member (Linton Formation)
Coal maps of Greene and Owen Counties
Six county coal maps showing locations of underground mines
Compilation of a bibliography of Indiana geology from 1956 through 1975
Report published on correlations in the Pennsylvanian System in the Illinois Basin
Reports published on the classification of clastic sediments, on the petrology and mineralogy of mudrocks, and on the distributions of fluvial channel systems in rocks of Pennsylvanian age
Sedimentology, stratigraphy, and history of the Indiana Dunes

Research Projects

General

Numerous samples from cores, mine exposures, and outcrops of clay, underclay, and shale were collected. Mineralogic and chemical analyses of samples were continued, and procedures for X-ray diffraction methods to determine the total mineralogy of the shales continued to be developed. Several professional papers were prepared, and research continued on geochemical and ceramic studies. We provided geologic data and counsel to two ceramic-tile producers, one of whom built a \$6.2 million plant in Bloomfield.

PENNSYLVANIAN BLACK SHALES

Samples of Pennsylvanian black shales continued to be collected and analyzed 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 study to determine why weathered shales show higher oil yields was completed, and several cores were taken to compare unweathered samples with weathered samples. A paper on this aspect of the study was published.

NEW ALBANY SHALE

Four professional papers discussing aspects of the New Albany Shale were prepared. A manuscript on the potential of the New Albany as a source of synthetic oil in Indiana was completed, a paper summarizing the stratigraphy of the New Albany in the Illinois Basin was written, a brief summary of oil-shale developments in Indiana during 1985 was compiled, and three one-page reports discussing the thickness, geophysical characteristics, and organic carbon of the New Albany were completed. The reports are all scheduled for publication by the Indiana Geological Survey (IGS) or in outside professional journals. Work continued on describing, sampling, and analyzing New Albany samples from cores given to the IGS by Phillips Petroleum.

Coal

PENNSYLVANIAN STRATIGRAPHY

This general project of the Coal and Industrial Minerals Section includes studies and contributions from all members of the section. This year data from Survey drill holes 342, 343, and 344 in eastern Posey County provided a detailed reference section for the Carbondale Group and parts of the Raccoon Creek and McLeansboro Groups. The core from these drill holes supplement and add to the geologic understanding of several rock units that have nearby type sections that are now obscured. Three members of the section continued activities on a tri-state committee to correlate Pennsylvanian rock units in the Illinois Basin.

DEEP-DRILLING PROGRAM FOR COAL

The deep-drilling program collects information on the deep coal resources of Indiana. In previous years the IGS has drilled 15 holes in six counties. During this past year Survey drill holes 342, 343, and 344 in Posey County contributed to our knowledge of coal resources and mining conditions for possible underground mines. Thick coalbeds of the Seelyville Coal Member (Staunton Formation) that were cored in one of the drill holes confirmed preliminary studies of the possibility for commercial reserves of this coalbed in Posey County.

COAL RESOURCES OF VANDERBURGH COUNTY

Work continued on determining the distribution, thicknesses, and stratigraphic relationships of coalbeds and related stratigraphic units in Vanderburgh County. Several cross sections showing stratigraphic relationships were compiled.

COAL RESOURCES OF GIBSON COUNTY

The project was completed and the report was submitted for publication by the IGS. Data derived from the study were used to prepare a report on coal deposition and tectonic control of sedimentation in the Illinois Basin.

COAL RESOURCES OF KNOX COUNTY

Work is progressing on maps showing the structure, thicknesses, and geologic discontinuities of coalbeds, sandstone thicknesses, and thicknesses of intervals between coalbeds. A report on the project was begun.

COAL RESOURCES OF VIGO COUNTY

A report on this project, which was completed previously, was published as IGS Special Report 34.

COAL RESOURCES OF SULLIVAN COUNTY

This project was completed. The coal geology and mining history of the county are discussed in the report, which includes maps showing the structure, thicknesses, and geologic irregularities of major coalbeds. The report is now awaiting drafting before publication by the IGS.

ROOF STABILITY AND GEOLOGIC DISCONTINUITIES IN COALBEDS

This is a continuing project to describe, map, and photograph discontinuities in Indiana coalbeds. Work is done as opportunities arise to enter mines where such discontinuities are encountered.

SUBSIDENCE CAUSED BY UNDERGROUND MINING OF COAL

A proposal was written to study undermined areas, depth and type of overburden, and past history of mine subsidence. The project is an extension of the project to map all underground mines on 7 1/2-minute quadrangle maps, and will be funded in part by the Indiana Division of Reclamation.

DEMETHANIZATION OF COAL

Several coalbeds cored in SDH 343 were desorbed and submitted to the U.S. Bureau of Mines in this continuing study to determine the methane content of coalbeds in Indiana.

GEOLOGIC CONDITIONS IN UNDERGROUND MINES IN THE SURVANT COAL MEMBER OF THE LINTON FORMATION

A report summarizing geologic and mining conditions encountered during past underground mining in the Survant Coal Member was completed and awaits drafting before publication by the IGS.

COMPILATION OF COALBED STRUCTURE AND THICKNESS MAPS IN SOUTHWESTERN INDIANA

Maps that show the structure and thickness of several Middle Pennsylvanian coalbeds in Vigo and Sullivan Counties and northern Knox County were prepared. These are a compilation of maps produced in connection with the county coal-resources projects.

COALS OF THE MANSFIELD AND BRAZIL FORMATIONS

The objective of this project is to map and evaluate the coal resources of the Mansfield and Brazil Formations. Work this year focused in Spencer, Daviess, and Greene Counties, where marker beds such as the Lead Creek Limestone Member were identified and their distribution and structure mapped.

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 Colchester Coal Members of the Petersburg and Linton Formations.

COAL MAPS OF GREENE AND OWEN COUNTIES

Mapping was completed in these counties, and the maps are awaiting drafting before publication.

COAL MAP OF POSEY COUNTY

New county base maps were being drafted at the end of the year. Compiled data on structure and thickness will be plotted on new bases for publication.

INDIANA COAL-DATA SYSTEM

As was reported last year, 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 and maps on abandoned mines, and the review and recalculation in part for the IGS's coal-analyses file, which was entered into the data system.

DATA ENTRY FOR THE NATIONAL COAL RESOURCES DATA SYSTEM (USGS FUNDED)

Data from coal maps continued to be digitized for entry into the USGS computer files. This is the last phase of data entry required before Indiana's coal-resource assessment can proceed. About one-third of the area underlain by coal-bearing strata in Indiana was digitized by the end of the year. To help with this phase of the project an IBM microcomputer and Summa-

graphics digitizer were acquired to help enter the data. Coal resources were computed for Clay County, Indiana.

MINE-MAP PROJECT (OSM FUNDED THROUGH DIVISION OF RECLAMATION)

More than 370 copies of the IGS's Coal Map series were distributed this year. Mapping of underground and surface mines on quadrangle maps was completed and updating of quadrangles showing surface mines was continued. Mine information continued to be added to the data base, which now contains more than 8,000 entries.

BLACKHAWK RECLAMATION PROJECT (OSM FUNDED THROUGH DIVISION OF RECLAMATION)

This 3-year study combines an evaluation of ground-water flow and determination of water chemistry at the abandoned Blackhawk Mine in Vigo County, where the Division of Reclamation buried gob and reclaimed the surface land. Water levels in 30 wells were monitored monthly. Water samples were also collected monthly from each well and analyzed for chemical contaminants.

Geology and Structure of Indiana

GEOLOGIC MAP OF INDIANA

Drafting of the map for this project was nearly completed.

FAULTING AND JOINTING

A study of the cause and effect of jointing in quarries in central and northern Indiana was completed, and a paper was prepared and submitted for publication. The gathering of jointing data continued in preparation for a map of Indiana showing bedrock jointing.

MAPS OF INDIANA SHOWING STRUCTURE ON TOP OF THE MUSCATATUCK GROUP AND ROCKS OF SILURIAN AGE

Compilation of 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), was continued.

Annotated Bibliography of Indiana Geology

The formatting, typing, and much of the editing of the annotated bibliography for the period from 1956 through 1975 was completed. This bibliography is intended for use by professional geologists, professionals in related fields, geology students, and interested laymen and contains citations and annotation for more than 3,000 publications that pertain to the geology of Indiana.

Limestone and Dolomite

SILURIAN REEFS IN NORTHERN INDIANA

Information from deepened sections in quarries and drilling data continued to be gathered to help evaluate reefs in northern Indiana as sources of aggregate and high-calcium limestone.

RELATIONSHIP OF THE NEW ALBANY SHALE AND ROCKFORD LIMESTONE TO SILURIAN REEF STRUCTURES IN GREENE COUNTY

Work continued on the manuscript for this project, which investigated the relationship of the thinning of the New Albany Shale to buried reef structures.

CARBONATE ROCK FILLERS AND WHITING

Information was gathered and tabulated 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 clays, pyrite, dolomite, and quartz. Optical and scanning electron microscopy and X-ray diffraction methods were used to help identify many of the very finegrained to microscopic mineral forms. Several university researchers conferred with us on the project.

Metal Deposits

About 1,200 water samples had been collected and analyzed by the end of the year for hydrogeochemical reconnaissances of Harrison, Orange, Washington, Lawrence, and Monroe Counties. Rock samples were also collected and analyzed, and reports were prepared for the counties. Several new occurrences of ore minerals were recorded, and a study of sulfur isotope values of sulfides was started for a paper to be presented at a conference in November.

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. A bibliography on meteorites from Indiana was compiled.

Sand and Gravel

SAND AND GRAVEL RESOURCES OF HUNTINGTON AND WHITLEY COUNTIES

Driller's logs of more than 1,000 water wells were collected and examined to determine the subsurface distribution of sand and gravel deposits in these resource-poor counties. A sand and gravel availability map for northern Huntington County and Whitley County was constructed.

Directory of Peat and Marl Operators

The directory of peat producers was revised. A copy of the directory was filed as an open-file report.

Stratigraphy of the Indiana Dunes

Four papers on the sedimentology, stratigraphy, and history of the Indiana Dunes were written. Two presentations on the geology of the area were given, and a field trip was led to the Mt. Baldy area near Michigan City.

Reports and Maps Published by the Geological Survey

Coal Maps

Weber, L. A., 1985, Map of Clay County, Indiana, showing locations of underground coal mines: Indiana Geol. Survey Coal Map 12.

Weber, L. A., 1985, Map of Owen County, Indiana, showing locations of underground coal mines: Indiana Geol. Survey Coal Map 13.

Weber, L. A., 1985, Map of Vermillion County, Indiana, showing locations of underground coal mines: Indiana Geol. Survey Coal Map 14.

Weber, L. A., 1985, Map of Parke County, Indiana, showing locations of underground coal mines: Indiana Geol. Survey Coal Map 15.

Weber, L. A., 1985, Map of Fountain County, Indiana, showing locations of underground coal mines: Indiana Geol. Survey Coal Map 16.

Weber, L. A., 1985, Map of Warren County, Indiana, showing locations of underground coal mines: Indiana Geol. Survey Coal Map 17.

Directories

Smith, C. R., 1985, Directory of sand and gravel producers in Indiana: Indiana Geol. Survey Directory, 46 p.

Ault, C. H., and Carr, D. D., 1985, Directory of crushed stone, ground limestone, cement, and lime producers in Indiana: Indiana Geol. Survey Directory, 36 p.

Special Reports

Harper, Denver, 1985, Coal mining in Vigo County, Indiana: Indiana Geol. Survey Spec. Rept. 34, 67 p.

Harper, Denver, 1985, The development of surface coal mining in Indiana: Indiana Geol. Survey Spec. Rept. 35, 54 p.

Unnumbered Publications

Ault, C. H., Haumesser, Andy, and Fraser, G. S., 1985, Geology and operations of the American Aggregates Corporation's Harding Street pit, quarry, and underground mine, Marion County, Indiana \unnumbered publication}: Indiana Geol. Survey, 8 p.

Ault, C. H., Oak. L. C., and Smith, C. R., 1985, Geology and operations of the Martin Marietta Basic Products Aggregates Division's Kentucky Avenue pit and underground mine, Marion County, Indiana \unnumbered publication}: Indiana Geol. Survey, 8 p.

Memorandum Reports

Ault, C. H., 1985 and 1986, Numerous memorandum reports for quarries in Indiana.

Ault, C. H., January 1985, Some geologic and environmental considerations for development of a business park near Jeffersonville, Clark County.

Ault, C. H., January 1985, Geologic report on a Borden Group outcrop in Tippecanoe County.

Micellaneous Publications

Ault, C. H., May 1986, Cause and effect of jointing in quarries in central and northern Indiana \abs.}: Program with Abs., Forum on Geology of Indus. Minerals, Arkansas Geol. Comm., p. 9.

Ault, C. H., 1986, Construction materials: crushed stone, in Bever, M. B., ed., Encyclopedia of materials science and engineering: Oxford, Pergamon Press Ltd., p. 813-820.

Carr, D. D., 1986, Construction materials: industrial minerals in Bever, M. B., ed., Encyclopedia of materials science and engineering: Oxford, Pergamon Press Ltd., p. 831-832.

Carr, D. D., 1986, Industrial minerals: an overview in Bever, M. B., ed., Encyclopedia of materials science and engineering: Oxford, Pergamon Press, Ltd., p. 2288-2290.

Carr, D. D., Freas, R. C., and Mason, B. H., 1985, Search for the young scientist begins: Mining Eng., v. 37, no. 10, p. 1246.

Carr, D. D., and Leininger, R. K., 1986, Indiana (review of mineral developments): Mining Eng., v. 38, no. 5, p. 325.

Chen, P-Y, and Shaffer, N. R., 1984, Classification of clastic sediments in Pennsylvanian coal-bearing formations emphasizing mudrock lithology: Ninth Internat. Cong. of Carboniferous Stratigraphy and Geology, Comptes Rendu, v. 3, pt. 3, p. 443-451.

Chen, P-Y, and Shaffer, N. R., 1984, Petrography and mineralogy of mudrocks of the Carbondale Group (Middle Pennsylvanian), Indiana: Ninth Internat. Cong. of Carboniferous Stratigraphy and Geology, Comptes Rendu, v. 3, pt. 3, p. 641-655.

Eggert, D. L., and Adams, S. C., 1985, Distribution of fluvial channel systems contemporaneous with the Springfield Coal Member (Middle Pennsylvanian) in southwestern Indiana: Ninth Internat. Cong. Carboniferous Stratigraphy and Geology, Comptes Rendu, v. 4, p. 342-348.

Hasenmueller, W. A., and Carr, D. D., 1985, Indiana: Keystone Coal Industry Manual, McGraw Hill, New York, p. 484-489.

Jacobson, R. J., Trask, C. B., Ault, C. H., Carr, D. D., Gray, H. H., Hasenmueller, W. A., Williams, D., and Williamson, A. D., 1985, Unifying nomenclature in the Pennsylvanian System of the Illinois Basin: Illinois Acad. Sci. Trans., v. 78, nos. 1-3, p. 1-11.

Miller, B. B., and Thompson, T. A., 1986, Molluscan succession in cores from Cowles Bog area, Indiana Dunes, Indiana \abs.}: Program and Abs., AMQUA 9th Bienn. Mtg., Indiana Univ.-Northwest, p. 151.

Shaffer, N. R., and Leininger, R. K., 1985, Oil yields of fresh and weathered oil shales of Indiana \abs.}: Abs. - 1985 Eastern Oil Shale Symposium, p. 32.

Shaffer, N. R., and Leininger, R. K., 1986, Oil yields of fresh and weathered oil shales of Indiana: Proc. 1985 Eastern Oil Shale Symposium; Kentucky Center for Energy Research Laboratory, Lexington, p. 277-282.

Thompson, T. A., 1986, Post Lake Chippewa transgression deposits in the Indiana Dunes National Lakeshore, in Hansel, A. K. and Johnson, W. H., Quaternary records of northeastern Illinois and northwestern Indiana: Field Guide for 9th Bienn. Mtg. of AMQUA, p. 39-44.

News Releases

On April 1, 1986, a news release was given to DNR for immediate release concerning thick Seelyville coal drilled in SDH 344 near Evansville.

Professional Activities

Papers and Posters Presented at Professional Meetings

Irwin, P. N., Weber, L. A., Carr, D. D., and Hasenmueller, W. A., November 15, 1985, Indiana coal-mine information project, Indiana Acad. of Sci., Bloomington, Ind.

Schubert, C. E. K., Warren, V. L., Hasenmueller, W. A., and Carr, D. D., November 15, 1985, Using the national coal resources data system to assist coal-resource investigations in Indiana, Indiana Acad. Sci., Bloomington, Ind.

Shaffer, N. R., and Leininger, R. K., November 20, 1985, Oil yields of fresh and weathered oil shales of Indiana, Eastern Oil Shale Symposium, Lexington, Ky.

Ault, C. H., May 6, 1986, Cause and effect of jointing in quarries in central and northern Indiana, Forum on Geology of Industrial Minerals, Little Rock, Ark.

Thompson, T. A., May 2, 1986, Development of the Late Wisconsinan to Early Holocene Calumet and Tolson Dune/Beach Complexes in the Indiana Dunes National Lakeshore, at the Indiana Dunes Symposium, IU-Northwest.

Organizational and Committee Activities

Don Carr was elected to Fellow of the Indiana Academy of Science on November 15.

Nelson Shaffer was accepted as a member of the American Chemical Society and the Society of Economic Geologists in May.

In June Denver Harper attended a nonfiction workshop of the IU Writer's Conference.

Public Lectures

Nelson Shaffer gave a lecture on sulfur isotopes and secondary minerals to some Indiana University geochemistry students October 1, 1985.

Nelson Shaffer spoke on oil yields of fresh and weathered shales to a group of IU students in a paleontology-sedimentology seminar December 10, 1985.

Nelson Shaffer lectured on hydrogeochemical exploration to an IU geology class December 12, 1985.

Denver Harper addressed a hydrology class at IU about carbonate polymorphs and their solution chemistry on March 6, 1986.

Todd Thompson made a presentation to the National Park Service at the Indiana Dunes National Lakeshore on "Stratigraphy and depositional history of the Southern Shore of Lake Michigan" on March 18, 1986.

Nelson Shaffer lectured on industrial minerals to Edward Ripley's IU G416 class April 7 and 9, 1986.

Curt Ault made a presentation on cementing of coals in petroleum tests at a DNR hearing April 23, 1986, at Evansville.

Don Carr gave a lecture on economic aspects of the Survey's research at a Department of Geology colloquium April 30, 1986.

Meetings Attended

On July 1, 1985, Don Carr attended a meeting of the Energy Development Board with John Patton and Dick Leininger.

On August 19, 1985, Don Carr attended a meeting of the Energy Development Board with John Patton and Dick Leininger.

On August 28, 1985, Don Carr attended a meeting of the Coal Study Group of the Energy Development Board.

On September 8, 1985, Nelson Shaffer attended a mineral show in Greenfield.

On September 13, 1985, Don Carr attended a meeting of the Industrial Byproducts Committee of the Corporation for Science and Technology.

On September 30, 1985, Curt Ault and Gerald Carpenter attended a meeting of the Commissioners of the DNR at Vincennes, where a proposal for regulating casing cementing depths in petroleum tests to protect coals was approved.

On October 5, 1985, Walt Hasenmueller attended a forum, "Advances in Coal Burning Technology," organized by Frank McCloskey, where Walt gave a presentation on Indiana's coal resources.

On October 21, 1985, Don Carr attended the fall meeting of the Indiana Limestone Institute of America.

On October 24, 1985, Denver Harper, Joe Hailer, and Ed Hartke attended a meeting in Indianapolis, "Indiana Ground water: Regulations, Risk Assessment, and Remedies," sponsored by the Indianapolis Center for Advanced Research, Inc., and Environmental Quality Control, Inc.

On October 27-30, 1985, Don Carr and Nelson Shaffer attended the annual meeting of the GSA in Orlando, Fla.

On November 13, 1985, Curt Ault, Walt Hasenmueller, and Don Carr met with the Tri-State Committee on Correlations in the Pennsylvanian System of the Illinois Basin at Henderson, Ky., and attended a field trip to examine rocks of the Dugger Formation.

On November 13, 1985, Nelson Shaffer attended Indiana Geologists.

On November 14, 1985, Don Carr, Chris Schubert, Vicki Warren, and Bob

Blakely attended a meeting of the Illinois-Indiana Section of the AIPG in Danville, Ill.

On November 15, 1985, Don Carr, Curt Ault, Nelson Shaffer, Nancy Hasenmueller, Paul Irwin, Vicki Warren, Chris Schubert, and Licia Weber attended a meeting of the Indiana Academy of Science in Bloomington.

On November 18-20, 1985, Nancy Hasenmueller and Nelson Shaffer attended the Eastern Oil Shale Symposium in Lexington, Ky.

On November 18, 1985, Don Carr attended an energy conference sponsored by the Indiana Energy Development Board. The concluding part of the meeting included a tour of the Survey, one stop of which was to the Coal Section.

On November 19, 1985, Don Carr attended a meeting of the Legislative Committee of the Indiana Mineral Aggregates Association.

On December 11, 1985, Don Carr, Nelson Shaffer, and Dick Leininger attended a meeting of Indiana Geologists at Indianapolis.

On January 14, 1986, Curt Ault and Don Carr attended a meeting of the Indiana-Kentucky Geological Society in Evansville.

On January 24, 1986, Don Carr attended a meeting of the executive committee of the Illinois-Indiana Section of AIPG at Terre Haute.

On January 29, 1986, Don Carr attended a meeting of the Coal Mining and Reclamation Task Force in Indianapolis.

On February 5, 1986, the Coal and Industrial Minerals Section held its annual review of projects. Bruce Mason, guest speaker from the France Stone Co., discussed exploration for limestone and dolomite and geologic solutions for operational problems in quarries.

On March 4-6, 1986, Don Carr attended the AIME annual meeting in New Orleans. At the Industrial Minerals Division luncheon, he made a presentation of the Young Scientist award to Roger Sharpe, geologist with U.S. Gypsum Co.

On March 8, 1986, Nelson Shaffer attended a gem and mineral show at Richmond.

On March 26, 1986, Don Carr attended a meeting of the Indiana Coal Mining and Reclamation Task Force at Indianapolis.

On March 31, 1986, members of the Coal and Industrial Minerals Section met and interviewed Emery Cleaves, candidate for State Geologist.

Paul Irwin, Walt Hasenmueller, and Lou Miller attended the Indiana Coal Mining Institute April 3-5, 1986, at Evansville.

Nelson Shaffer attended a gem and mineral show April 20, 1986, at Cincinnati.

Paul Irwin and Curt Ault attended a management seminar April 21 and 22, 1986, at McCormicks Creek State Park.

On April 23, 1986, Don Carr attended the Research Expo meeting sponsored by Research and Graduate Development of Indiana University.

Nelson Shaffer attended the North-Central Geological Society meeting at Kent State University April 24-26, 1986.

In April 1986, members of the Coal and Industrial Minerals Section conducted interviews with four candidates for the State Geologist's position, Donald Carr, Norman Hester, Gordon Everett, and Thomas Straw.

In April 1986, as a candidate for the State Geologist's position, Don Carr spent 2 days in interviews with faculty and administrators of Indiana University, members of the Survey, members of the search and screen committee for the State Geologist, and administrators of the Department of Natural Resources.

Nelson Shaffer and Don Carr attended the SEPM Forum on global Sedimentary Geology May 3-4, 1986, at Indiana University.

Curt Ault attended the Forum on Geology of Industrial Minerals May 5-8, 1986, at Little Rock, Ark.

Todd Thompson attended the First Indiana Dunes Research Conference at IU-Northwest May 1-2, 1986.

On May 29, 1986, Don Carr attended a meeting of the Coal Mining and Reclamation Task Force in Indianapolis.

On June 9-11, 1986, Denver Harper attended the Second Workshop on Mine Subsidence at Morgantown, W. Va.

Nelson Shaffer attended a workshop on quantitative X-ray diffraction at the National Bureau of Standards in Gaithersburg, Ma., June 23-24, 1986. He also attended a rock swap June 13 and 14 at Bedford.

Field Trips

Curt Ault, Nelson Shaffer, and Chris Smith led trips through the American Aggregates's Harding Street Mine and the Martin Marietta Kentucky Avenue Pit and Mine for about 100 attendees of the National Stone Association meeting in Indianapolis on July 16, 1985.

Nelson Shaffer led three IU graduate students on a trip to see Mississippian carbonate rocks at road cuts near Bloomington and Mitchell on July 29, 1985.

Nelson Shaffer attended a field trip to view epigenetic mineralization in northwestern Ohio as part of a GSA meeting in April 1986.

On April 4, 1986, Don Carr led a field trip for one of Noel Krothe's classes to look at Salem and Harrodsburg exposures south of Bloomington.

Curt Ault attended two Forum field trips to study mineral resources of southwestern Arkansas May 5 and 8, 1986.

Todd Thompson led a trip to the Indiana Dunes June 5, 1986, for the American Quaternary Association.

Miscellaneous Activity

Chris Smith resigned from the Survey July 24, 1985. He accepted a position in California as a hydrologist with a consulting firm, Anderson-Nichols.

On September 14, 1985, Don Carr discussed Indiana industrial minerals on a radio talk show of WATI in Danville.

The Coal and Industrial Minerals Section received 31 applications for the open position in the area of sand and gravel research. A committee, consisting of Don Carr, Curt Ault, Nelson Shaffer, and Maurice Biggs, met early in October 1985, to evaluate the candidates. References were requested for the six selected for further evaluation.

In January 1986, Nelson Shaffer, Peg Ennis, and Dick Leininger contributed petrologic and chemical data to a paper about aragonite in Wyandotte Cave, which received the best paper award at the National Speleological Society meeting.

Todd Thompson began work February 3, 1986, filling the position with the Coal and Industrial Minerals Section vacated by Chris Smith last year.

In March 1986, Nancy Hasenmueller completed an EIS questionnaire for a bridge in Warrick County.

In March 1986, Don Eggert completed two EIS questionnaires for bridges in Gibson County.

On May 27, 1986, Ed Ripley began working on a 4-week project to study the occurrence of metals in organic-rich shales.

DRAFTING AND PHOTOGRAPHY SECTION

Permanent Personnel

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

Other Personnel

James P. Struhs.Drafting Assistant
(July 1, 1985 to August 24, 1985)
Mike RetterDrafting Assistant
(September 8, 1985 to March 27, 1986)

Orientation and General Activities

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, photomicrography, field photography, color proofing of maps and artwork, and preparation of projection slides

Completed Projects or Major Parts of Projects

Jobs completed for publication by the Geological Survey are: Bulletin 59, Compendium of Paleozoic Rock-Unit Stratigraphy in Indiana--A Revision; Special Report 35, The Development of Surface Coal Mining in Indiana; Special Report 36, Alluviation of the Ohio River Valley near Evansville, Indiana, and Its Effect on the Distribution of Sand and Gravel in the Area; Special Report 37, Conodonts from the Subsurface Champlainian (Ordovician) Rocks of Eastern Indiana; Special Report 38, Origin of Mid-Channel Islands in the Ohio River near Evansville, Indiana; Occasional Paper 51, Environmental Geologic Considerations in Koontz Lake, Starke County, Indiana, and its 6-Mile Fringe; Occasional Paper 52, Evaluation of Seismometer Arrays for Earthquake Locations; Occasional Paper 53, The Ordovician-Silurian Unconformity in Southeastern Indiana; Mineral Economics Series 31, Oil Development and Production in Indiana During 1984; Directory of Coal Producers in Indiana; Directory of Crushed Stone, Ground Limestone, Cement, and Lime Producers in Indiana; Miscellaneous Map 46, Map of Indiana Showing Structure on Top of and Oil Productive Area of the Black River Group (Ordovician); Miscellaneous Map 27, Map of Southwestern Indiana Showing Locations of Active Coal Mines (rev.); Coal Map 12, Map of Clay County, Indiana, Showing Locations of Underground Coal Mines; Coal Map 13, Map of Owen County, Indiana, Showing Locations of Underground Coal Mines; Coal Map 14, Map of Vermillion County, Indiana, Showing Locations of Underground Coal Mines; Coal Map 15, Map of Parke County, Indiana, Showing Locations of Underground Coal Mines; Coal Map 16, Map of Fountain County, Indiana, Showing Locations of Underground Coal Mines; Coal Map 17, Map of Warren County, Indiana, Showing Locations of Underground Coal Mines; 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 Coal Map Series and the Petroleum Exploration Map series. The base maps completed are: Clay, Fountain, Owen, Parke, Vermillion, and Warren counties. Exhibits were prepared for the Indiana State Fair and for a meeting of the Coal Mining Institute. A hallway display on petroleum was completed. A map showing published petroleum Exploration Maps was revised. Illustrations were completed for six reports on the petroleum geology of the Illinois Basin and for seven other papers for

outside publications. Slide drawings were prepared for 8 talks.

Other jobs in progress include Special Report 39, Upper Silurian and Lower Devonian Stratigraphy of the Central Illinois Basin; Special Report __, Geology and Coal Deposits of the Clinton Area, West-Central Indiana; Miscellaneous Map 48, Bedrock Geologic Map of Indiana; a base map of Posey County, Indiana, scale 1:63,360; Indiana State Fair exhibit for 1986; and illustrations for three outside publications.

Photographic items produced consist of 1,976 camera copies, duplicate negatives, and film positives; 1,274 black and white prints; 44 field and laboratory photographs; 20 photomicrographs; 37 stripping film prints of stick-up type and symbols; 20 scribesheets; 123 peelcoal films; and 432 slides.

The production numbers, taken from Drafting and Photography work orders, have been increased 10% to account for add-on and remakes, and include only orders completed for the Geological Survey during 1985-86.

Approximately 44,960 square feet of prints were produced on the diazo printer.

EDUCATIONAL SERVICES SECTION

Permanent Personnel

John R. Hill.Geologist and Head

Other Personnel

Kim Fennie.Technical Assistant
(January 1, 1968 to April 4, 1986)
Jane ReevesTechnical Assistant
(September, 1985 to December 14, 1985)

Orientation and General Activities

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 1985-86 the Educational Services geologist recorded 443 conferences, six field trips, and 353 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. Also, during the fiscal year 161 information packets were mailed, 67 special-service requests were met, 45 lectures delivered (mostly to schools), and 41.5 field days were logged in discharging section obligations.

Status of Projects

Revision of Gold and Diamonds in Indiana

Revision of Blatchley's ever-popular "Gold and Diamonds in Indiana" was completed. The new version contains all of Blatchley's historic information in the form of direct quotations, but half of the manuscript consists of contemporary glacial theory, mineral-provenance factors, origins of gold and diamonds, and sedimentological factors concerning the transport and deposition of gold and diamonds.

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 of the Division of Reclamation and the Geological Survey. This file has become one of the most complete photographic documentations of any research effort conducted by the Survey. Subject matter within each of the separate files is constantly updated as new information, techniques, and equipment make such photography necessary.

Video program

An ongoing program to generate earth-science-education video tapes was approved this past year. We are trying to buy base-line professional video equipment for this section so that in-house projects can be started. The I.U. Telecommunications Department has agreed to produce and prepare a pilot project treating the geology of Turkey Run State park. Taping for the project will begin in the fall of 1986.

John Hill will take training in video-tape field methods from the Telecommunications Department this fall.

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. No new additions to this series were completed this year.

Miscellaneous Activities

The Educational Services Section geologist, with help from Drafting and Photography Section staff, worked on the 1986 State Fair exhibit for the Geological Survey.

A new petroleum display was designed and prepared for the Petroleum Section display case. Construction of the display was mostly the work of the Drafting Section illustrator. The new display illustrates concepts of petroleum production, exploration, and refining.

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

Material was prepared for use in 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, rock and fossil specimens, and field-trip guidebooks (mostly from the spring meeting of the Indiana Academy of Sciences).

An article entitled "Where to Go & What to See: Places of Geologic Interest in Indiana" was written for and published in Rocks & Minerals. The article appeared in the May/June 1986 issue of the magazine.

Considerable effort was spent this year working with naturalists from various state properties, both in supplying them with technical information about the geology of their respective parks and in lecturing to groups for which they had responsibility.

A handout on the geology of Indiana (both bedrock and unconsolidated systems) was prepared. It was written in response to many questions that come to this section concerning an overview of Indiana geology.

The section geologist consulted, with help from Geology Section personnel, on a gasoline spill that affected the spring flowing from Pless Cave near Bedford.

Oblique black-and-white, color and false-color IR photographs were taken of the Grayville cutoff that developed along the Wabash River near Grayville, Indiana. The shots were made from the IDNR Aerocommander 500 twin-engine airplane.

An annotated bibliography of all geologic articles that have appeared in

Outdoor Indiana was completed using PC-File.

The section geologist consulted with Dr. Brown (IU Medical Center surgeon) concerning a leaky water impoundment on his property near Gosport.

Reports and Maps Submitted for Publication

Circulars

Hill, J.R., Gold and diamonds in Indiana: an update: Indiana Geol. Survey Circular, 66p., 6 figs., 2 pls.

Articles Printed in Outdoor Indiana

Hill, J. R., 1986, Springing to Life: Outdoor Indiana, volume 51, number 2, pages 4-9.

Hill, J. R., 1986, Blast from the Past: Outdoor Indiana, volume 51, number 3, pages 3-7.

Miscellaneous Publications

Hill, J. R., 1986, Where to Go & What to See: Places of Geologic Interest in Indiana: Rocks & Minerals, volume 61, number 3, pages 164-167.

Professional Activities

Public Lectures

The following lectures were given: the geology and geomorphology of Monroe County to 20 school teachers, from various schools in the midwest; the geology and geomorphology of the Knobstone Escarpment to 25 or 30 campers at Starve Hollow Lake; the "Geology of Indiana and Its Implications to Industrial Mineral Production" to tour guides from the Indiana State Museum; earthquakes (including a tour of the seismic laboratory) to 28 high-school students; the geologic history of Indiana to the Indiana Geology and Gem Society in Indianapolis (IUPUI); the functions of the Geological Survey to members of the Indiana Energy Development Board; plate tectonics of the Middle East to a geography class at Union Bible Seminary; origins of rocks and minerals to more than 100 students at Pleasantview Elementary School (Zionsville); origins of rocks and minerals to students at Dyer and Child's Elementary Schools; five lectures on the geology of the French Lick area to participants in Forestry Field Days; a talk on fossils to local residents; origins of rocks and minerals to St. Charles Elementary (Bloomington); the functions of the Indiana Geological Survey to the Evansville Lapidary Society; the mapping program of the Indiana Geological Survey to students at Evansville University; Pennsylvanian geology of Indiana to students at Donnan Jr. High (Indianapolis) in cooperation with Amax Coal Co. public relations program; six lectures on the bedrock and glacial geology of Putnam County to many students from Greencastle Middle School; multiple lectures on caves to students from Edgewood Jr. High; geology of caves and karst region to students from Manchester College; the functions of Indiana Geological Survey to gifted and talented students from all over the Midwest; geology of Buckner's Cave to Chicago-area students; services of my section to 60 naturalists from all over Indiana (arranged by Mike Ellis, Chief Naturalist); four lectures on geodes

and their origins to local girl scout group at Beachwood Heights; karst hydrology and geology of south-central Indiana to 24 gifted and talented students brought to us by Indiana University special education staff.

Field Trips

The following field trips were wholly or partly prepared and conducted by the Educational Services geologist: (1) Six 45-minute lectures were given on the local geology of Fern Cliff in Putnam County. The lectures and group discussions were part of an outing for the Greencastle Middle School. This is now an annual event. (2) A guidebook was prepared and a field trip was run for the spring meeting of the Indiana Academy of Sciences. The field trip, "A Geologist's View of Spring Mill State Park," included three stops within Spring Mill State Park: Twin Caves, the stream along the campground, and Donaldson Cave. (3) A special field trip was run for 20 school teachers from Hans Anderson's summer Prime Time series course on the sciences. The trip was restricted mostly to the Mitchell Plain karst region. (4) Portions of a special field trip to the Chinook Mine were prepared by this section in conjunction with officials of the Amax Coal Co. The field trip was directed to underprivileged and problem high-school students from the Indianapolis metropolitan area. (5) A karst field trip including a crawling tour of parts of Buckner Cave was provided for students from Manchester College.

GEOCHEMISTRY SECTION

Permanent Personnel

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

Other Personnel

Lisa Chase	Laboratory Assistant
	(September 8, 1985 to May 3, 1986)
Stephen Diehl	Laboratory Assistant
	(August 25, 1985 to April 19, 1986)
Timothy Fritz	Laboratory Assistant
	(September 8, 1985 to January 25, 1986)
Andrew Hardy	Laboratory Assistant
	(September 8, 1985 to February 22, 1986)
Marvin Hill	Laboratory Assistant
	(January 26, 1986 to May 3, 1986)
Monique Hunt	Laboratory Assistant
	(September 8, 1985 to May 3, 1986)
Keith Might	Laboratory Assistant
	(September 8, 1985 to April 19, 1986)
Richard Presley	Laboratory Assistant

Kirk RohrkasteLaboratory Assistant
 (January 11, 1986 to May 3, 1986)
 Matthew Soliday.Laboratory Assistant
 (February 26, 1986 to April 19, 1986)
 Scott SzpakowskiLaboratory Assistant
 (September 8, 1985 to May 3, 1986)
 Thomas Toth.Laboratory Assistant
 (September 8, 1985 to May 3, 1986)
 Scott ZipprichLaboratory Assistant
 (August 25, 1985 to October 5, 1985)

Orientation and General Activity

Staff of the Geochemistry Section provide geochemical analyses of rock, soil, and water samples that are usually collected and submitted by geologists of other sections within the Survey. Although the section is essentially service oriented, geochemical research is also an important contribution..

During the fiscal year, 1985-86, Joseph Hailer of the Geochemistry Section became intensively involved in sampling and analyzing of samples for characterization of ground water for projects in cooperation with the Division of Reclamation, the Division of Water, and geologists of the Geological Survey.

In March 1985 we embarked on a 2 1/2-year study to monitor quality and quantity of water within the Blackhawk coal-waste reclamation site in Vigo County. The project requires monthly measurements, sampling, and analysis of about 30 wells to detect and characterize the changes in water quantity and chemistry following reclamation. We have observed significant decreases in the concentrations of leachate in samples from wells directly on the site as reactions move toward equilibrium. Evidence has been found, however, of increases in products of weathering of pyrite in wells offsite, though the natural buffering capacity of surrounding natural materials appears to be absorbing noxious components. During next fiscal year we will be in the final stages of the original project and will be involved in delineating the interaction of surface water and ground water, particularly the connections between surface strip-mine lakes and the flooded underground mine beneath the site.

We generated and carried out the field and laboratory program to provide the water quality data of the Division of Water's projects investigating the ground-water resource in the St. Joseph and Whitewater River basins. Reports including the data will be prepared within the Division of Water.

As part of the Geological Survey's program in Environmental Geology we have participated in the project concerning the recently urbanized counties, Hamilton and Tipton, north of Indianapolis. With Ed Hartke we have collected and analyzed more than 150 samples of ground water from more than 100 sites. An important aspect of this work has been the cooperative efforts of the State Board of Health and the Department of Environmental Management in the analysis of selected samples for residues of agricultural pesticides. To date no evidence of a selected set of substances has been found.

Analysis has also been provided for a study of ground water in Monroe

County for Nelson Shaffer's project of exploration geochemistry.

These four endeavors have involved analyses of more than 1,000 samples. Considerable effort has been required to provide the necessary sampling and analytical methodology.

In addition to Joe Hailer's efforts, those of field assistants and full-time employees Peg Ennis, Jim Johnson, and Dick Leininger should be mentioned.

Traditional work of characterization of the geologic materials of Indiana has continued with the sampling and preparation of cores obtained by or contributed to the Survey. Additional field samples collected by geologists, especially of the Coal and Industrial Minerals Section, have also been handled. One project is that of determining paleontologic, mineralogic, and chemical compositions of slightly different lithologies within the "building-stone facies" of the Salem Limestone. The paleontologic and mineralogic work is by a student in the I.U. Department of Geology; general core description is by Don Carr; and chemical analysis is by Peg Ennis. Peg used the coulometric method in the Department of Geology for determination of carbon dioxide and the ICP spectrometer in our laboratory for determination of other major and minor components.

More than 2,300 samples were submitted to the preparation laboratory and an additional 650 from a backlog of core samples accounted for a total of 2,350 samples prepared for analysis. Physical tests such as modulus of rupture, specific gravity, and absorption characteristics were made on 435 samples. Lou Miller has supervised the work carried out by Jay Arnold and student assistants. More than 1,300 samples were run or supervised by Peg Ennis to determine total carbon, hydrogen, and nitrogen, and more than 550 were analyzed for major components. Extensive use of the X-ray diffraction equipment was made by geologists; maintenance of the equipment by the Geochemistry Section continues.

Lou Miller and a student assistant obtained more than 1300 determinations on coal and other samples in the coal analysis laboratory. Total sulfur content of various samples is determined instrumentally in the laboratory. Lou devoted considerable effort in checking analytical data in conjunction with Walter Hasenmueller's examination of geographic, geologic, and sampling data for the computerization of the information. Together the two wrote a paper on the sulfur content of Indiana coal. Their work was facilitated by Jim Johnson's familiarity with data processing.

Service work, in addition to small chemical and mineralogic investigations for the Coal and Industrial Minerals Section, included several questions concerning staining of Indiana Limestone.

Professional Activities

Meetings Attended

Joe Hailer attended meetings concerning ground water, Lou Miller attended a Mining Institute meeting in Springfield, Ill., the International Conference on Coal testing at Lexington, Ky., an ACS meeting on sulfur in coal at Carbondale, Illinois, and the Indiana Academy Science meeting at Butler

University. Dick Leininger attended a meeting on sulfur in coal at Columbus, Ohio, one on radon in the environment at Washington, D.C., the Pittsburgh Conference on Analytical Chemistry and Applied Spectroscopy in Atlantic City, and the Eastern Oil Shale Symposium in Lexington, Ky. For the latter Dick also attended a meeting of the program committee.

GEOLOGY SECTION

Permanent Personnel

Robert H. Shaver. . . . .	.Paleontologist and Head
Ned K. Bleuer . . . . .	.Glacial Geologist
Gordon S. Fraser . . . . .	.Geologist
Samuel S. Frushour. . . . .	.Geologic Technician
Henry H. Gray	Head Stratigrapher
Edwin J. Hartke . . . . .	.Environmental Geologist
Carl B. Rexroad	Paleontologist
M. Sue Terrell. . . . .	.Secretary

Other Personnel

David Dick.	Laboratory Assistant
	July 2, 1985 to July 26, 1985
	September 4, 1985 to April 2, 1986
Gregory Dipple. . . . .	.Field Assistant
	July 1, 1985 to September 10, 1985
Tom Gibboney.	Laboratory Assistant
	January 27, 1986 to April 29, 1986
Julie Gordon.	Laboratory Assistant
	September 10, 1985 to May 1, 1986
Andrew Gremos	Laboratory Assistant
	September 3, 1985 to April 10, 1986
	Field Assistant
	May 13, 1986 to June 30, 1986
Timothy Irving.	Laboratory Assistant
	September 4, 1985 to April 30, 1986
Charles Keener.	Laboratory Assistant
	August 25, 1985 to February 6, 1986
Martin Lytle.	Laboratory Assistant
	July 1, 1985 to August 8, 1985
Bridgette McCarthy.	Laboratory Assistant
	February 9, 1986 to April 23, 1986
William E. Nellist.	Geological Assistant
	July 1, 1985 to August 23, 1985
Kim Nelson.	Geological Assistant
	September 8, 1985 to June 30, 1986
Thomas Skirvin. . . . .	.Field Assistant
	November 15, 1985 to June 30, 1986
Krista Spaulding.	Laboratory Assistant
	September 3, 1985 to May 2, 1986
	Geological Assistant
	May 4, 1986 to June 30, 1986

Jenny R. Tankersley	Research Assistant July 8, 1985 to June 30, 1986
John B. Tweddale.	Field Assistant June 16, 1986 to June 30, 1986
Eric Wells.	Field Assistant June 20, 1986 to June 30, 1986
Bruce Wilcer.	Geological Assistant July 2, 1985 to June 10, 1986

Orientation and General Activities

The Geology section is charged with collecting, storing, interpreting, and disseminating stratigraphic (including glacial stratigraphic), paleontologic, and variously applied 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 government 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. Much of this activity has been carried on under the label "environmental geology."

During the 1985-86 year, the section recorded 391 conferences and special field trips and 1,290 items of correspondence, much of this statistical accounting being referable to user requests. In addition 172 environmental questionnaires were completed, and three memorandum reports were prepared, all by request. Environmental questionnaires relate to partly federally funded projects that include road, street, bridge, industrial park, sewer and water, airport, power, and still other kinds of construction works.

A part of the statistical accounting given above relates to educational services, and to this may be added some of the emphases found in the 25 professional papers, posters, and public lectures delivered by members of the section. Two formal field trips conducted, singly or with others, also qualify.

During the year the section carried on 12 regularly listed formal projects (one of which has six subprojects). Three projects were completed; three new projects were begun. Two other projects, on general character and engineering properties of unconsolidated materials, are not included in these tallies, but they were carried on through well augering, sampling, and logging programs and through an analytical-testing program in the section's sedimentation laboratory. In all these programs, these field- and laboratory-based statistics apply: man days in field, 351; sections and feet of section measured, 21 and 1,799; holes gamma-ray and electric logged, 133 and 24,108; water samples collected, 141; rock and fossil collections, 1,618; holes and feet of hole augered, 4 and 45; and laboratory tests, 1,458.

Status of Projects

Quaternary Map of Indiana

This project, begun in 1982-83, was completed. Submission for publication of the new state Quaternary map (scale, 1:500,000) signifies culmination of a long-standing program, conceived during the 1950's, to provide new state geologic maps. It is a companion, therefore, of the eight 1°x 2° Regional Geologic Maps (scale, 1:250,000); of the three single-sheet state maps (scale, 1:500,00) that show bedrock topography, thickness of unconsolidated materials, and bedrock geology; and of page-size maps that show these same things at a much reduced scale. Only the single-sheet Quaternary and bedrock-geology maps remain unpublished.

In addition to the state Quaternary map, four published, submitted, and oral reports stemming from this project are listed (Gray) in other parts of this annual report.

This series is a most remarkable up-to-date product, considering status of mapping in many other states, and it is perhaps the most fundamental statement that a geological survey can make about its function. The success of this effort is owed largely to H. H. Gray, who has made this series so much a part of his professional life's work. He may be proud, and no doubt he understands the way in which all of us wish to share in the organizational pride attaching to these maps.

Quaternary Stratigraphic and Sedimentological Studies

A new project, "Aquifers of the Kankakee River Basin," was begun, with cooperative funding through the Division of Water, and was taken to perhaps one-quarter completion. It is a pilot study of sorts, as it is the first such comprehensive study we have undertaken among several others we might undertake as parts of the Division of Water's plans to study the statewide water resource, using nine major drainage basins as the organizational vehicle. The sections's responsibility is to outline the geology of especially the Quaternary aquifers but the bedrock aquifers as well. Understanding the quantity, availability, and protectability of the water resource is to understand first of all the spatial distribution and internal nature of the water-bearing rock bodies. A program of augering, sampling, well logging, and collection of already-available data was undertaken especially by several temporary employees and was well underway by the end of the fiscal year.

Six subprojects in Quaternary sedimentation were advanced: (1) Lake Michigan sedimentation, (2) Middle Wabash Valley alluviation, (3) Whitewater River terrace deposits, (4) Kankakee valley sedimentation, (5) Daviess County glacial lake sediments, and (6) White River sedimentation. The Kankakee subproject has been merged with the more embracive Kankakee basin project noted above.

A collective total of nine published, submitted, and oral reports and a conducted field trip stemmed from these subprojects and are listed (Fraser, Fraser and Gray, and Gray) in other parts of this annual report. These reports relate to mineral resources and environmental geology and add generally to scientific knowledge.

Two long-standing Quaternary stratigraphic projects were advanced to near completion: (1) Pleistocene stratigraphy of west-central Indiana and (2) Teays Valley of Indiana. A collective total of nine published, submitted, and oral reports stemming from these projects are listed (Bleuer, Bruns and others) on other pages of this annual report. Three of these items (Bleuer) are substantial reports relating to stratigraphy, drainage, and geomorphology of the buried preglacial Teays Valley. The three published maps (Bruns and others), cooperative with the Division of Water, show detailed configuration of the Teays Valley and its tributaries, and they apply directly to the buried valley as a reservoir for ground water.

These projects should be completed soon on submission of two reports on glacial stratigraphy and on the geologic history of the Teays drainage system.

Biostratigraphic, Paleontologic, and Paleocologic Activities

Conodont-biostratigraphic studies were actively carried on under the aegis of four formally listed projects dealing with Middle Ordovician, Upper Silurian, Middle Mississippian, and Upper Mississippian needs in correlation of Paleozoic bedrock units and in reconstruction of various paleogeographic, sedimentological, and paleocologic settings. One of these projects (Middle Ordovician) was completed. In addition, miscellaneous conodont ecologic studies were carried on with certain Pennsylvanian strata (by request) and with some Middle Mississippian strata in the Greencastle area. The latter study suggests a thermal anomaly in that area (perhaps relating to mineralization).

A collective total of 17 published, submitted, and oral reports stemming from these conodont activities are listed (Rexroad; Rexroad and Mapes; Rexroad and Nicoll; Ethington, Droste, and Rexroad; Merrill, Rexroad, and others; Norby and Rexroad) on other pages of this annual report.

Other biostratigraphic, paleontologic, and paleocologic studies included those on amino acids deriving from Quaternary mollusks and those on Silurian reef and interreef faunas. Six published, submitted, and oral reports listed on other pages relate to these studies. (See Miller, Bleuer, and others, "Misc. Pubs."; for the other five items, see listings herein under "Paleozoic Stratigraphic Activities.")

Paleozoic Stratigraphic Activities

Two formal projects dealing with Paleozoic stratigraphy were carried on, the long-standing "Middle Paleozoic Geology of the Southern Great Lakes Area," which has covered for Silurian and Devonian investigations throughout Indiana, and "Mississippian Rocks of Northwestern Indiana." The latter project deals with lower Middle Mississippian carbonate rocks as facies of the silty rocks of the Borden delta. This project remained in the data-gathering stage, that is, in core drilling and study of the cores.

The Siluro-Devonian investigations are represented by a collective total of seven published, submitted, and oral reports that are listed (Droste and Shaver; Shaver) on other pages of this annual report.

Two other stratigraphic reports, not stemming from formal projects, were published (listed on other pages as Laferriere and others and Jacobson, Gray, and others).

Environmental Geology and Other Applied Activities

The section carried on three formal environmental geology projects: (1) Environmental geology of Monroe County, (2) Environmental geology of Hamilton and Tipton Counties, and (3) Water movement and quality and associated mine subsidence at the Blackhawk gob-pile reclamation site in Vigo County.

The Monroe County project was completed with submission of a substantial manuscript that will have many practical applications to planners, developers, landowners, and engineers. See Hartke and Gray listing under "Reports . . . submitted . . . ").

The Hamilton-Tipton project was begun anew and will result eventually in a report similar to that for Monroe County. Some 20 environmental geology reports for the state's most populous counties and metropolitan areas have now been produced (or are now under way: Hamilton-Tipton) during the past 18 years.

The Blackhawk reclamation project, although new for the Geology section, has been an ongoing project for the Coal and Industrial Minerals Section. E. J. Hartke now represents the section for the hydrogeologic and water-quality emphasis.

E. J. Hartke represented the Survey on three separate state interagency committees and working groups related to increasing concerns in various quarters about the state's ground-water resource, its availability, quality, management, and protection. (See Hartke listings under "Professional Activities.")

One of three memorandum reports (Shaver) filed during the year relates to the erosion problem at New Harmony along the Wabash River.

Miscellaneous Activities

Members of the section attended 15 professional meetings; reviewed dozens of professionally prepared manuscripts and proposals for research grants; served as members, panelists, and chairpersons for 10 outside professional groups; delivered 26 oral talks and papers; and conducted two formal field trips. Also, one member (Rexroad) served as president of the internationally composed conodont-research group known as the Pander Society.

Reports and Maps Published by the Geological Survey

Miscellaneous Map

Bruns, T. M., Logan, S. M., and Steen, W. J., 1985, Map showing bedrock topography of the Teays Valley, western (central, eastern) part, north-central Indiana: Indiana Geol. Survey Misc. Maps 42-44.

Gray, H. H., Droste, J. B., Patton, J. B., Rexroad, C. B., and Shaver, R. H., 1985, Correlation chart showing Paleozoic stratigraphic units of Indiana: Indiana Geol. Survey Supp. Misc. Map 48.

Occasional Paper

Norby, R. D., and Rexroad, C. B., 1985, Vogelgnathus, a new Mississippian conodont genus: Indiana Geol. Survey Occasional Paper 50, 14 p., 3 pls., 5 figs.

Reports and Maps Submitted for Publication

Miscellaneous

Droste, J. B., and Shaver, R. H., (Eight articles on Silurian and Devonian rocks): Indiana-Kentucky Geol. Soc., 8 p., 20 figs.

Fraser, G. S., Elimination of waste products from midcontinent glaciers \abs.}: Program for midyear meeting of Soc. Econ. Paleontologists and Mineralogists, 1 p.

Gray, H. H., Quaternary geologic map of Indiana (scale, 1:500,000): Indiana Geol. Survey Misc. Map.

Gray, H. H., Ice-marginal drainage along the glacial boundary in southeastern Indiana \abs.}: Indiana Acad. Sci. Proc., 1 p.

Mapes, R. H., and Rexroad, C. B., Conodonts from the Imo Formation (upper Chesterian), north-central Arkansas: Palaeontologica et Geologica, 28 p., 2 pls., 2 figs., 1 table.

Shaver, R. H., A history of the study of North American Silurian reefs, Illinois and Appalachian Basins to Northern Greenland: Bull. Canadian Petroleum Geology spec. volume, 37 p., 33 figs.

Occasional Paper

Laferriere, A. P., and others, The Ordovician-Silurian unconformity in southeastern Indiana: Indiana Geol. Survey Occasional Paper, 25 p., 13 figs.

Special Report

Bleuer, N. K., Notes on the stratigraphy, chronology, and, dynamics of the Late Wisconsinan glaciation of central Indiana: Indiana Geol. Survey Spec. Rept., 49 p., 7 figs.

Ethington, R. L., Droste, J. B., and Rexroad, C. B., Conodonts from subsurface Champlainian (Ordovician) rocks of eastern Indiana: Indiana Geol. Survey Spec. Rept., 55 p., 5 figs., 2 pls., 1 table.

Hartke, E. J., and Gray, H. H., Geology for environmental planning in Monroe County, Indiana: Indiana Geol. Survey Spec. Rept., 75 p., 1 pl., 12 figs. 1 table.

Report of Progress

Bleuer, N. K., Nomenclature of the Lafayette Bedrock Valley System and the Marion-Mahomet (Teays) Drainage System in Indiana: Indiana Geol. Survey. Rept. Prog. 28 p., 1 fig., 2 tables.

Memorandum Reports

Frushour, S. S., September 30, 1985, Establishment of surface positions corresponding to positions in Donaldson Cave, Spring Mill State Park, Indiana: 7 p., 2 figs.

Hartke, E. J., October 2, 1985, Preliminary reports on the geology of three sites near Princeton and Seymour, Indiana: 3 p.

Shaver, R. H., July 22, 1985, Assessment of erosion problems along the lower Wabash River near Grayville and New Harmony, Indiana and Illinois: 17 p., 3 figs.

Miscellaneous Publications

Droste, J. B., and Shaver, R. H., 1985, comparative stratigraphic framework for Silurian reefs--Michigan Basin to surrounding platforms, in Cercone, K. R., and Budai, J. B., eds., Ordovician and Silurian rocks of the Michigan Basin and its margins: Michigan Basin Geol. Soc. Spec. Paper 4, p. 73-93, 22 figs.

Droste, J. B., and Shaver, R. H., 1986, Paleooceanography of the Late Silurian seaway in the midwestern basins and arches region (abs.): Geol. Soc. America Abs. with Programs, v. 18, 1 p.

Fraser, G. S., 1985, Sedimentological consequences of two catastrophic floods in the Late Wisconsinan Wabash Valley (abs.): Geol. Soc. America Abs. with Programs, v. 17, 1 p.

Fraser, G. S., 1986, Lake levels and shoreline erosion: a historical perspective (abs.): Indiana Water Resources Assoc. Proc. 7th Ann. Water Resources Symposium, p. 21.

Jacobson, R. J., and others \incl. H. H. Gray}, 1985, Unifying nomenclature in the Pennsylvanian System of the Illinois Basin: Illinois Acad. Sci. Trans., v. 78, p. 1-11, 2 figs.

Merrill, G. K., Austin, R. L., Bitter, Peter von, and Rexroad, C. B., 1985, Phylogenetic expression of genetic relationships and apparatus compositions among Carboniferous carboniferous conodonts (abs.), in Aldridge, R. J., Austin, R. L., and Smith, M. P., eds., Fourth European Conodont Symposium (ECOS IV), p. 20-21.

Miller, Barry, Bleuer, N. K., and others, 1986, A fossiliferous magnetically reversed Quaternary site from Pike County, southwestern Indiana (abs.): Geol. Soc. American Abs. with Programs, v. 18, 1 p.

Rexroad, C. B., and Nicoll, R. S., 1985, Re-examination of Silurian conodont clusters from northern Indiana (abs.): Fourth European Conodont Symposium (ECOS IV), p. 26.

Rexroad, C. B., and Merrill, G. K., 1985, Conodont biostratigraphy and paleoecology of Middle Carboniferous rocks in southern Illinois: Cour. Forsch.-Inst. Senckenberg, v. 74, p. 35-64, figs., 4 pls, 5 figs.

Rexroad, C. B., and Mapes, R. H., 1986, Correlation of the Imo Formation (upper Chesterian) north-central Arkansas) on the basis of conodonts (abs.): Geol. Soc. America Abs. with Programs, v. 18, p. 262.

Shaver, R. H., 1985, A case history: Silurian reefs of northeastern North America, one of the great fossil reef systems (abs.): Geol. Soc. America Abs. with Programs, v. 17, 1 p.

Professional Activities

Papers and Posters Presented at Professional Meetings

Droste, J. B., and Shaver, R. H., Paleooceanography of the Late Silurian seaway in the midwestern basins and arches region: Paleontological Society symposium on midcontinent paleooceanography, North-Central Section Geological Society of America, Kent, Ohio, April 24, 1986.

Fraser, G. S., Lateral input and longitudinal transport down the Wabash River during latest Wisconsinan: Geological of Society America, Orlando, Florida, October 28-30, 1985.

Fraser, G. S., Climatic controls in lake levels in the Lake Michigan-Lake Huron basins: Indiana Water Resources Association, Pokagon State Park, June 3, 1986.

Gray, H. H., Ice-marginal drainage along the glacial boundary in southeastern Indiana: Indiana Academy of Science, Bloomington, November 15, 1985.

Merrill, G. K., Austin, Ronald, von Bitter, Peter, and Rexroad, C. B., Phylogenetic expression of genetic relationship and apparatus composition among cavusgnathoid conodonts: Fourth European Conodont Symposium, Nottingham, England, July 26, 1985.

Rexroad, C. B., and Nicoll, Robert, Re-examination of Silurian conodont clusters from northern Indiana: Fourth European Conodont Symposium, Nottingham, England, July 26, 1985.

Rexroad, C. B., Correlation of the Imo Formation (upper Chesterian) north-central Arkansas) on the basis of conodonts: Pander Society symposium, Geological Society America, Memphis, Tenn., April 3-6, 1986.

Shaver, R. H., A case history: Silurian reefs of northeastern North America, one of the great fossil reef systems: Geological Society America History of Geology Division symposium, Orlando, Fla., October 29.

Organization and Committee Activities

N. K. Bleuer presented a progress report on a NASA-supported project (Hilton Johnson, Stanley Totten, N. K. Bleuer, G. S. Fraser) on "Identification of Low-Relief Glacial Landforms Utilizing SIR-B Imagery" to the NASA-SIR-B Working Group, Jet Propulsion Laboratory, Pasadena, May 2.

H. H. Gray, C. B. Rexroad, and R. H. Shaver participated in a planning session with personnel of the Illinois, Indiana, and Kentucky Geological Surveys to outline an Illinois Basin volume for a basin series planned by the American Association of Petroleum Geologists, Bloomington, October 2.

H. H. Gray and R. H. Shaver served as member and chairperson respectively of the Survey's Geologic Names Committee.

E. J. Hartke served as map and illustrations editor for the Survey.

E. J. Hartke served as a member of the Confined Disposal Facility Study Group, an arm of the Department of Natural Resources, meetings in Indianapolis and Lansing.

E. J. Hartke participated in a Water Resources Information Conference, sponsored by a state interagency ground-water committee, Turkey Run State Park, April 4-5.

E. J. Hartke served as a member of the Indiana Interagency Ground Water Task Force, which has produced an imposing document addressing the state's ground-water resource and the need for greater knowledge, management, development, and protection.

C. B. Rexroad served as the Pander Society's Chief Panderer during the year 1985-86 and will serve in that same capacity for 5 years.

C. B. Rexroad chaired the annual business meeting of the Pander Society, Memphis, April 4.

R. H. Shaver participated in a workshop to plan the Illinois Basin Ultradeep Drillhole, a project of the federally sponsored program to explore the deep continental interior, April 1-4.

R. H. Shaver chaired a scientific session for the Paleontological Society at its North-Central Section Geological Society of America meeting, Kent State University, Ohio, April 24.

R. H. Shaver was awarded Honorary Membership status in the Soc. Econ. Paleontologists and Mineralogists at the annual meeting of the society in Atlanta, June 16. Also, he received an award of appreciation from the Society as a past editor of the Journal of Paleontology.

Public Lectures

N. K. Bleuer gave a talk on "Downhole Geophysical Logging of Glacial Deposits" to the Indiana Geologists, February 12.

N. K. Bleuer (with Greg Olyphant) presented a seminar on "Nature of Glacier Flow in the Lower Midwest . . . (and) Testing Synchronicity of Glacier Flow" to the Indiana University Quaternary Research Group, February 17.

N. K. Bleuer gave a talk on "Downhole Logging of Glacial Deposits" to Purdue University engineering and geology students, March 5.

G. S. Fraser gave a talk on "Lateral Input vs. Longitudinal Transport in the Glacial Wabash River" to the Purdue University Geology Colloquium, September 5, and to the IUPUI Geology Colloquium,

G. S. Fraser and H. H. Gray (with Cheryl Munson) gave a talk on "Impact of Sedimentary Style on Human Habitation in the Ohio River valley" to the Indiana University Quaternary Research Group, November 11.

G. S. Fraser (with Cheryl Munson) gave a talk to the Indiana University Quaternary Research Group on "Impact of Sedimentary Style on Human Habitation in the Ohio River Valley--a Continuation," November 18.

H. H. Gray gave a talk on "Relict Drainageways Associated with the Glacial Boundary in Southern Indiana" to the Geological Survey Seminar, January 17.

H. H. Gray gave a talk on "Floodplain Sedimentation in the Ohio River" to the Indiana University Quaternary Institute Seminar, November 11.

C. B. Rexroad gave six lectures on various conodont subjects to the Institute of Geology, Beijing; Chendu Institute of Geology and Mineral Resources, Chendu, Sichuan; and Inst. Karst Geology, Guilin, Guanxi; when he visited the Peoples Republic of China, November.

C. B. Rexroad gave two talks on "Geologic and Other Views of Peoples Republic of China," one to the Indiana University Paleontology Seminar, January 22, and one to the Geological Survey Seminar, January 20.

Meetings Attended

C. B. Rexroad attended the Fourth European Conodont Symposium at Nottingham, England, to conduct business of the Pander Society, July 20-August 2.

G. S. Fraser attended meetings of the Indiana Geologists, October 9, November 13, and December.

G. S. Fraser and R. H. Shaver attended the Geological Society of America and Paleontological Society annual meeting in Orlando, Fla., October 27-31.

H. H. Gray, Sam Frushour, and R. H. Shaver attended the Indiana Academy of Science meeting in Bloomington, November 15.

C. B. Rexroad attended the joint meeting of the Southeastern and South-Central Sections of the Geological Society of America, Memphis, April 2-6.

N. K. Bleuer attended the annual field-conference meeting of Friends of the Pleistocene, Baton Rouge, Louisiana, April 18-20.

R. H. Shaver attended the Geological Society of America North-Central Section meeting at Kent State University, April 23-24.

N. K. Bleuer attended the NASA-sponsored "Second Symposium on Spaceborne Radar Imaging" at the Jet Propulsion Laboratory, Pasadena, Cal., May 1.

G. S. Fraser, as one of the local hosts, and R. H. Shaver attended the Society of Economic Paleontologists and Mineralogists Forum on Global Sedimentology, Indiana University, May 4-5.

N. K. Bleuer attended the American Quaternary Association Biennial Meeting, theme on "Glacial Marginal Environments," Urbana, Illinois, June 2-3.

R. H. Shaver attended the Am. Assoc. Petroleum Geologists and Society Economic Paleontologists and Mineralogists Meeting in Atlanta, June 15-17.

Field Trips

C. B. Rexroad and J. R. Hill conducted a field trip on "The Geology of Spring Mill State Park," Indiana Academy of Science spring field trip, April 26.

G. S. Fraser helped to conduct a field trip on "The Quaternary Geology of Northeastern Illinois and Northeastern Indiana," American Quaternary Association, June 5.

GEOPHYSICS SECTION

Permanent Personnel

Maurice E. Biggs	Geophysicist and Head
Robert F. Blakely	Geophysicist
Chi-Kin (George) Lam	Geophysicist (From May 15, 1986)
Joseph F. Whaley	Geophysicist (To July 26, 1985)
Thomas W. Chitwood	Geophysical Assistant
E. Coleen George	Principal Secretary
Samuel L. Riddle	Driller

Other Personnel

Cynthia Anderson	Programmer (July 1, 1985 to August 9, 1985)
Gregory Brown	Programmer (November 21, 1985 to May 3, 1986)
Paul Dodd	Field Assistant (May 27, 1986 to June 30, 1986)

Kathy Doege.	Clerical Assistant (February 11, 1986 to June 30, 1986)
William Gaddis	Field Assistant (July 1, 1985 to August 22, 1985)
Kathy Hovasse.	Clerical Assistant (February 13, 1986 to April 24, 1986)
Joseph Loyall.	Programmer (July 1, 1985 to August 7, 1985)
Steven Mehay	Laboratory Assistant (September 13, 1985 to December 13, 1985)

Orientation and General Activities

Joseph Whaley, a member of the Geophysics Section for 33 years, died after a brief illness on July 26, shortly after the start of the 1985-86 fiscal year. During his long service, Joe had been in charge of geophysical field measurements and instrumentation. Using a variety of geophysical techniques, he had been responsible for more than 12,000 seismic refraction determinations, several hundred seismic reflection records, nearly 3,000 gravity observations, and many electrical resistivity surveys, and had built an electrical logging system that he used to log Geological Survey drill holes until the section obtained commercially built logging equipment. Joe was a sound and effective scientist, and the loss of his experience and integrity was a major setback to the Geological Survey's geophysical program.

At the time of his death, Joe was directing a large program to measure the gravitational field over the northern half of Indiana at stations spaced about 1 mile apart. This work was to complement a similar survey completed by geophysicists from Purdue University over the southern half of the state. When the total project is completed, these measurements will aid greatly in the interpretation of the deeply buried rocks that form the ancient foundation of Indiana. After Joe's death, Bill Gaddis, a field assistant in the program, continued to make gravity measurements in east-central Indiana during the remainder of the 1985 field season.

In May 1986, George Lam accepted a position as a geophysicist with the Geological Survey. With Paul Dodd as a field assistant, he resumed the program of gravity measurements in Blackford and Grant Counties in eastern Indiana. By the end of June, they had occupied 400 stations at a spacing of 1 mile between observations. During the last 2 months of the fiscal year, they also reviewed the raw field data that Bill Gaddis had collected during the previous field season and arranged it in systematic form. By the end of June, George had organized the data for computation and inclusion in the gravity-data file.

George also participated with Gary Pavlis of the Geology Department in a seismic field project at the Kentland disturbed area in northwestern Indiana. This project is intended to take advantage of tomographic techniques similar to those used in medical diagnosis to obtain a three-dimensional perspective of the Kentland feature by seismic methods.

Bob Blakely, geophysicist and the Geological Survey's computing expert, retired on June 30 after 37 years with the organization. During the 1985-86 fiscal year he worked to bring several projects to a conclusion, or at least

to a point from which other staff could continue the developmental work. These projects included the final phases of a petroleum data base and information-retrieval system, processing of geochemical data, continuation of programs to plot geophysical logs to any selected scale for easy correlation, an inventory-control system, and an invoice system for the Publications Section.

In other work, Bob organized the physical-testing procedures so that they might be carried on by technical staff. The tests most commonly required by consultants, companies, and other state agencies are those designed to evaluate stone products for use in construction. Bob simplified these tests and associated computations into a stepwise format for ease of handling. More scientific measurements related to elastic, electrical, and thermal properties of Indiana's rocks await the arrival of a new geophysicist.

PETROLEUM SECTION

Permanent Personnel

Gerald Carpenter . . . . .	.Geologist and Head
Brian D. Keith	Geologist
Stanley J. Keller.	Geologist
John A. Rupp	Geologist
Dan M. Sullivan.	Geologist
Jerry Burton . . . . .	.Geological Assistant
James T. Cazee . . . . .	.Geological Assistant
Sherry Cazee . . . . .	.Geological Assistant
Rebecca Covey. . . . .	.Senior Records Clerk (from December 16, 1985)
Shelley S. Fox . . . . .	.Senior Records Clerk (to January 1, 1986)
Patsy Starks . . . . .	.Secretary and Curator of Records (to September 20, 1985)
Marie Williams . . . . .	.Secretary and Curator of Records (from September 23, 1985)

Other Personnel

Cynthia Anderson . . . . .	.Clerical Assistant (September 8, 1985-May 3, 1986)
Zorka Antolovic . . . . .	.Geological Assistant (May 19, 1986-June 28, 1986)
Shawn Boehm. . . . .	.Laboratory Assistant (August 25, 1985-May 3, 1986)
Pamela Dubois. . . . .	.Clerical Assistant (July 1, 1985-January 4, 1986)
John Federle . . . . .	.Laboratory Assistant (September 8, 1985-May 3, 1986)
Kerry Gaza . . . . .	.Laboratory Assistant (September 8, 1985-May 3, 1986)
Paul Hickner . . . . .	.Laboratory Assistant

Robert Knable.	Laboratory Assistant (May 13, 1986-June 28, 1986)
Joe Loyall.	Clerical Assistant (September 8, 1985-September 27, 1985)
Kevin McKee.	Laboratory Assistant (July 1, 1985-July 13, 1985)
David McPherson.	Laboratory Assistant (February 4, 1986-May 3, 1986)
Sean Morris.	Laboratory Assistant (September 8, 1985-December 20, 1985)
David Posey.	Laboratory Assistant (September 8, 1985-May 3, 1986)
Jeff Swanson	Laboratory Assistant (September 8, 1985-May 3, 1986)
Tom Weber.	Geological Assistant (January 6, 1986-June 18, 1986)
Rea Williams	Clerical Assistant (January 6, 1986-June 28, 1986)

Orientation and General Activities

Many conferences with representatives of the petroleum industry and with the general public are held annually by members of the staff of the Petroleum Section. Visitors to the section numbered 549 during the year. Many requests for assistance or information that are received either by mail or telephone are also processed by the staff. Telephone requests were routinely received and processed and incoming letters, which numbered 430, were also handled.

Compilation of estimates of the undiscovered potential gas reserves in Indiana was effected and submitted to the Potential Gas Committee as part of a nationwide effort to determine potential gas reserves of the United States. The committee publishes revision of these estimates annually.

As a safeguard against loss, data for well completions received during the year were microfilmed and placed on microfiche and maintained as a separate data file from the paper copies from which they were taken.

Compilation of drilling statistics for the state was performed and assimilated into a nationwide total performed by the American Petroleum Institute and the American Association of Petroleum Geologists. These statistics are published annually by the AAPG and are available on a world wide distribution basis.

An article summarizing petroleum exploration activity in the state was submitted to the AAPG and was included in an annual issue of the Bulletin that reports on exploration activity for the previous year.

A review of the drilling and producing record of the state's petroleum industry was compiled and published as an annual publication in the Geological Survey's Mineral Economics Series.

Maps in the Survey's Petroleum Exploration Map Series were updated and revised during the year. Maps for 42 counties were updated and revised and 50 were reviewed and found to need no revision. In addition to maps for these 92 counties, maps for 14 counties showing the structural position of the base of the Beech Creek Limestone were revised.

Reports and Maps Submitted for Publication by the Geological Survey

Preparation of Mineral Economic Series No. 31 by Gerald Carpenter and Stanley Keller was completed and submitted for publication on August 22.

The manuscript for the Subsurface Stratigraphy of the Blue River Group (Mississippian) in Indiana, prepared by John Droste and Gerald Carpenter, was submitted for critical review on November 13.

Reports and Maps Published and Submitted for Publication

Miscellaneous

John Rupp submitted an abstract concerning his poster session presented at the annual meeting in Lexington, Ky., of the Kentucky Oil and Gas Association. The abstract will be published in the proceedings of the Association.

Brian Keith coauthored a manuscript with Dan Fara for submission to the American Association of Petroleum Geologists as part of a Symposium Volume to be published by the AAPG.

John Rupp coauthored with Brian Keith a paper reviewing the future hydrocarbon potential of the Illinois Basin for inclusion in a section on this aspect of the AAPG Sag Basin Report.

Gerald Carpenter submitted to the Illinois Geological Survey a complete set of maps covering the Illinois Basin portion of Indiana that depicted the areal distribution of each of the individual producing stratigraphic units in that portion of Indiana. The maps are to be combined with similar data covering the Illinois and Kentucky portions of the Illinois basin to show complete areal distribution of individual producing units in the Basin and are to become a part of the AAPG publication on sag basins of the world. A similar set of maps was prepared and sent to Avery Smith to be compiled as part of the publication being prepared by the Indiana-Kentucky Geological Society.

Gerald Carpenter compiled and submitted to the AAPG the annual development paper concerning petroleum exploration and production in Indiana during 1985.

John Rupp completed a manuscript for submission to Volume 95 "Proceedings of the Indiana Academy of Science" entitled "The Backbone Limestone, a potential new reservoir in southern Indiana".

Dan Sullivan submitted a paper to the Illinois Geological Survey concerning oilfield reserves in the Indiana portion of the Illinois Basin. The paper is to be a part of the volume on Sag Basins of the world to be published by the American Association of Petroleum Geologists.

News Releases

Gerald Carpenter was interviewed by a reporter from the Evansville Press newspaper for an article being prepared concerning the oil industry of Posey County.

Gerald Carpenter prepared an article concerning a review of 1984 exploration and development in Indiana and a forecast of activity for 1985. The article was requested for inclusion in an annual oil issue of the Evansville Press.

Professional Activities

Organization and Committee Activities

Stanley Keller prepared a midyear report on drilling activities in Indiana for the Potential Gas Committee. Stanley is a member of that committee and reports on the potential gas reserves for Indiana.

Gerald Carpenter participated in a workshop conducted by the AAPG and the American Petroleum Institute for the Committee on Statistics of Drilling. The work of this committee, of which Gerald is a member, is in transition with the API transferring compilation of the basic data to Petroleum Information Corporation instead of CSD committee members. Information so compiled by Petroleum Information is to be checked by CSD committee members for final approval before release as official drilling statistics.

John Rupp and Gerald Carpenter attended an organizational meeting of the staff from the USGS, the Illinois State Geological Survey, the Indiana Geological Survey, the Kentucky Geological Survey, and the Missouri Geological Survey. The group met to plan the requirements needed for completing the Paducah 1° x 2° CUSMAP project. Following the 1-day organizational meeting, a 2-day field trip in the fluorospar district of southern Illinois and northern Kentucky was made by the group.

John Rupp attended a meeting of the Underground Injection Practices Council in Denver, Col. The meeting was primarily a workshop on mechanical integrity diagnosis and testing that lasted for 4 days.

All members of the professional staff are members of the American Association of Petroleum Geologists and the Indiana-Kentucky Geological Society. In addition, Stanley Keller is a member of Indiana Geologists; Brian Keith is a member of the Society of Economic Paleontologists and Mineralogists and Indiana Academy of Science; John Rupp is a member of the Geological Society of America, Indiana Academy of Science, Society of Economic Paleontologists and Mineralogists, and the Society of Mining Engineers of the American Institute of Mining Engineers; Gerald Carpenter is a member of the Indiana Oil and Gas Association.

Stanley Keller and Brian Keith are assisting the Indiana-Kentucky and Illinois Geological Societies in preparing volume 2 of the Illinois Basin pool-studies to be published by the joint societies. Stanley is acting as pool studies coordinator for Indiana and Brian is regional-papers coordinator. All geologists of the Petroleum Section are members of the Indiana-Kentucky Geological Society and are contributing to the publication. Brian and Stanley attended a meeting of the publication committee in Evansville on January 27.

Public Lectures

John Rupp addressed the May meeting of the Indiana-Kentucky Geological Society in Evansville on the topic "Harrodsburg Limestone in the Newtonville Consolidated field, Spencer County. Among the attendees were Gerald Carpenter, Brian Keith, Stanley Keller, and Dan Sullivan.

Brian Keith presented an invited talk at the 17th annual Appalachian Petroleum Geology Symposium, held at Morgantown, W. Va. Title of Brian's talk was "Regional Geology and Reservoir Development in Trenton Limestone of Eastern North America."

John Rupp presented a paper at the annual meeting of the Indiana Academy of Science held in Bloomington. John's paper dealt with the stratigraphy and petroleum potential of the Backbone Limestone in Indiana. Other members of

the section staff attended a half day of the sessions.

John Rupp presented a talk on well-site geology to a class at the University of Louisville. The talk was requested by the University of Louisville Geology Department as part of a series given by visiting lecturers.

John Rupp presented a talk to a Geoscience class at Purdue University on "Careers in the Geosciences." John's work on the atlas of geologic maps of Indiana is now approximately 88 percent completed.

Brian Keith attended the midyear meeting of the SEPM in Golden, Colo. While there he presented a talk titled "Top of the Trenton Limestone in Indiana -- Sub-Aerial Unconformity or Submarine Discontinuity" as part of a symposium on paleokarst.

Dan Sullivan presented a talk at the Indiana Historical Society's Spring History Conference in May. A special program commemorated the centennial of the 1886 discovery of natural gas in Indiana. Dan's presentation dealt with the post-Trenton Field period, and John Patton discussed the impact of the early Trenton gas discovery. Tapes of talks are available to the 6,000 membership of the society.

Dan Sullivan also provided background information for various newspaper articles appearing during the centennial year.

John Rupp prepared and presented a talk on the use of a contouring package, an Indiana University computer software system, to a colloquium made up of members of the Geological Survey staff, BACS, and the Division of Water of the DNR.

Meetings Attended

Dan Sullivan, Stanley Keller, and Gerald Carpenter attended the opening meeting of the Indiana-Kentucky Geological Society on September 11 in Evansville.

Dan Sullivan, Stanley Keller, and Brian Keith attended the October meeting of the Indiana-Kentucky Geological Society in Evansville. Dr. Janis Treworgy, Illinois State Geological Survey, spoke on "A Tectonically Influenced Ramp During Chesterian Time." Her talk dealt chiefly with the clastic units in part of the Stephenson Group in the Illinois Basin.

Dan Sullivan and Stanley Keller attended the November meeting of the Indiana-Kentucky Geological Society in Evansville.

Stanley Keller, John Rupp, Brian Keith, and Gerald Carpenter attended the January 14 meeting of the Indiana-Kentucky Geological Society in Evansville. Speaker for the evening was Robert Ginsberg, AAPG Distinguished Lecturer from Miami, Fla. who spoke on modern carbonate environments.

Dan Sullivan attended the April meeting of the Indiana-Kentucky Geological Society at which AAPG Distinguished Lecturer Dr. Ronald C. Surdam, University of Wyoming, spoke on "Predictive Models for Sandstone Diagenesis."

Gerald Carpenter attended the annual meeting of the American Association of Petroleum Geologists held in Atlanta, Ga. in May.

Stanley Keller and Gerald Carpenter attended (along with other Geological Survey representatives) a meeting of personnel from the Indiana, Kentucky, and Illinois Geological Surveys. The meeting, held in Bloomington, was for the purpose of formulating plans for preparation of a portion of a volume to be published by the AAPG on "Sag Basins of the World." The portion of the volume to be prepared by the three geological surveys is to be used as a model for other basins to be included in the volume. The Illinois State Geological Survey is to act as coordinator for the material prepared for the Illinois Basin.

Field Trips

Stanley Keller, John Rupp, Dan Sullivan, John Droste, and Henry Gray participated in a field trip to examine exposures of the Buffalo Wallow Group in Perry, Crawford, and Dubois Counties on November 7 and 8. Henry Gray acted as leader of the group.

Brian Keith attended a field trip on Pennsylvanian carbonates and a core workshop on carbonate reservoirs in the Rocky Mountain area. Both of these were held in conjunction with the annual SEPM midyear meeting in Golden, Colo. in August.

Reviews

John Rupp and John Patton coauthored a review of the book entitled, "Petroleum Geology," by N. K. North.

Miscellaneous Activities

Dr. Patton, John Rupp, and Gerald Carpenter met with representatives of the Louisville Gas and Electric Co. (a geologist and two attorneys) to discuss the potential for the occurrence of natural gas on a property in Harrison County. Some litigation involving use of natural gas on the property is underway.

Three state-highway bridge-building proposals were evaluated by Stanley Keller for geologic or mineral considerations in the vicinity of the site work.

Brian Keith prepared a memo to J. C. Randolph of the Alternate Energy and Petroleum Committee of the Energy Development Board on its plan for future funding submitted to the Corporation for Science and Technology.

On September 19, Dan Sullivan, Stanley Keller, and Gerald Carpenter attended the annual Independent Oil Producers Association outing in Mt. Vernon as guests of the association.

Dan Sullivan compiled reserves figures for all of Indiana's oilfields. Although these numbers were formerly compiled by Dan as the Geological Survey's contribution to a nationwide total of oil reserves that were published annually by a committee of the American Petroleum Institute, Dan had not maintained annual revision of the figures since the committee disbanded in 1981. According to Dan's calculations, the recoverable oil reserves for Indiana as of 1-1-85 were 31,830,000 barrels.

Stanley Keller, Brian Keith, and Gerald Carpenter assisted in providing a guided tour of Petroleum Section facilities to a group from the Indiana Energy Development Board.

Gerald Carpenter attended a meeting conducted by the Department of Natural Resources Conservation Commission held in Vincennes. Among items on the agenda considered by the commission was one concerning protection of coal seams by oil operators and clarification of the term "mine string." The commission voted to delay a decision of the matter and request legislative action to define explicitly what protection is sufficient to preserve the coal resource.

Stanley Keller, Gerald Carpenter, and Dan Sullivan attended the annual Illinois Oil and Gas Association outing at the invitation of Gallagher Drilling Co. The outing was held July 18 at the Olney, Ill. country club.

Brian Keith spent a day in Chicago for a demonstration of GEM data base system to judge its applicability to the petroleum well file data base. The

system runs on a VAX mini-computer and appears to be ideally suited for use with the Petroleum Section well file.

Dan Sullivan in company with Clarence Dillon reviewed in the field and established operator contact concerning the new pipeline installation in Union-Bowman Consolidated Field. This is the first natural gas gathering system in Indiana in recent years and will be reviewed in the report on Natural Gas Fields. Dan also attended the last meeting of the 1985-86 year of the Indiana-Kentucky Society in Evansville.

PUBLICATIONS SECTION

Permanent Personnel

Gerald S. Woodard. Editor and Head
Pat Gerth. Principal Records Clerk
Barbara A. Semerau Senior Records Clerk

Orientation and General Activities

During the past fiscal year the Publications Section sold 5,597 reports and 13,575 maps. The section sent 902 reports and 114 maps on exchange to institutions in the United States and in foreign countries. It also distributed without charge 1,593 reports and 1,612 maps to members of its own organization and to individuals, libraries, and companies in the United States and abroad. The Publications Section served 5,026 office customers, handled 5,083 incoming and 1,330 outgoing letters pertaining to geologic reports and maps, and sent 902 announcements of new publications.

Eight reports, 11 new maps, and 78 revised maps were issued during the fiscal year, and four reports and the publications list were reprinted.

Twelve manuscripts of Survey reports, 18 abstracts and 39 manuscripts prepared by Survey personnel for outside publication, and 18 news releases, newsletters, exhibits, and similar material were edited during the fiscal year. Camera copy for 15 miscellaneous projects was prepared.

Proofreading by the editor of the camera copy of the "Annotated Bibliography of Indiana Geology -- 1956 Through 1975," prepared by secretaries in the Coal and Industrial Minerals Section using IBM personal computers and IBM Wheelwriter 5 typewriters, was completed during the fiscal year. The annotated bibliography will be published as Bulletin 60 during the 1987 calendar year. The annotating and indexing of post-1975 reports and maps pertaining to Indiana geology will be continued during the 1986-87 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 still in progress, but a program for maintaining inventory was not started.

Reports and Maps Published by the Geological Survey

Coal Maps

Weber, L. A., 1985, Map of Clay County, Indiana, showing locations of underground coal mines: Coal Map 12. Scale, 1 inch equals approximately 1 mile.

Weber, L. A., 1985, Map of Owen County, Indiana, showing locations of underground coal mines: Coal Map 13. Scale, 1 inch equals approximately 1 mile.

Weber, L. A., 1985, Map of Vermillion County, Indiana, showing locations of underground coal mines: Coal Map 14. Scale, 1 inch equals approximately 1 mile.

Weber, L. A., 1985, Map of Parke County, Indiana, showing locations of underground coal mines: Coal Map 15. Scale, 1 inch equals approximately 1 mile.

Weber, L. A., 1985, Map of Fountain County, Indiana, showing locations of underground coal mines: Coal Map 16. Scale, 1 inch equals approximately 1 mile.

Weber, L. A., 1985, Map of Warren County, Indiana, showing locations of underground coal mines: Coal Map 17. Scale, 1 inch equals approximately 1 mile.

Directories

Ault, C. H., and Carr, D. D., 1985, Directory of crushed stone, ground limestone, cement, and lime producers in Indiana: Unnumbered Directory, 36 pages, 1 figure, 1 table.

Hasenmueller, W. A., 1986, Directory of coal producers in Indiana: Unnumbered Directory, 60 pages, 18 figures.

Smith, C. R., 1985, Directory of sand and gravel producers in Indiana: Unnumbered Directory, 46 pages, 1 figure.

Mineral Economics Series

Carpenter, G. L., and Keller, S. J., 1985, Oil development and production in Indiana during 1984: Mineral Economics Series 31, 53 pages, 3 figures, 5 tables.

Miscellaneous Maps

Bruns, T. M., Logan S. M., and Steen, W. J., 1985, Map showing bedrock topography of the Teays Valley, western part, north-central Indiana: Miscellaneous Map 42. Scale, 1:100,000, in color.

Bruns, T. M., Logan, S. M., and Steen, W. J., 1985, Map showing bedrock topography of the Teays Valley, central part, north-central Indiana: Miscellaneous Map 43. Scale, 1:100,000, in color.

Bruns, T. M., Logan, S. M., and Steen, W. J., 1985, Map showing bedrock topography of the Teays Valley, eastern part, north-central Indiana: Miscellaneous Map 44. Scale, 1:100,000, in color.

Gray, H. H., Droste, J. B., Patton, J. B., Rexroad, C. B., and Shaver, R. H., 1985, Correlation chart showing Paleozoic stratigraphic units of Indiana: Miscellaneous Map 48 Supplementary Chart.

Hasenmueller, W. A., 1985, Map of southwestern Indiana showing locations of active coal mines (revised): Miscellaneous Map 27. Scale, 1 inch equals approximately 6 miles.

Occasional Papers

Lienert, B. R., Frazer, L. N., and Rudman, A. J., 1986, Evaluation of seismometer arrays for earthquake evaluation: Occasional Paper 52 (Geophysical Computer Program 11), 53 pages, 9 figures, 7 tables.

Norby, R. D., and Rexroad, C. B., 1985, Vogelgnathus, a new Mississippian conodont genus: Occasional Paper 50, 14 pages, 3 plates, 4 figures, 1 table.

Petroleum Exploration Maps

Revised Petroleum Exploration Maps (as of December 31, 1985): 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); 19A (Putnam County); 21A, 21B, and 21C (Dubois County); 23, 23A, and 23C (Knox County); 25A (Lawrence County); 26, 26A, and 26C (Davies County); 28A and 28C (Crawford County); 30 and 30A (Harrison County); 39, 39A, and 39C (Spencer County); 40, 40A, and 40C (Perry County); 42A (White County); 43A (Carroll County); 51, 51A, and 51C (Pike County); 52, 52A, and 52C (Vanderburgh County); 53, 53A, and 53C (Gibson County); 54, 54A, and 54C (Posey County); 55A (Steuben County); 56A (Lagrange County); 64A (Marshall County); 65A (Fulton County); 67A (Pulaski County); 69A (LaPorte County); 70A (Porter County); 71A (Jasper County); 74A (Miami County); 75A (Wabash County); 76 and 76A (Huntington County); 77 and 77A (Wells County); 79 and 79A (Jay County); 81 and 81A (Delaware County); 82 and 82A (Grant County); 83A (Howard County); 84A (Switzerland County); 96A (Shelby County); 97A (Rush County); 98A (Hamilton County); and 99A (Madison County).

Checked Without Revision Petroleum Exploration Maps (as of December 31, 1985): 15A (Parke County); 16A (Vermillion County); 17A (Fountain County); 18A (Owen County); 20A (Montgomery County); 22A (Jackson County); 24A (Monroe County); 27A (Orange County); 29A (Washington County); 31A (Brown County); 32A (Bartholomew County); 33A (Hendricks County); 34A (Marion County); 35A (Morgan County); 36A (Johnson County); 37A (Tippecanoe County); 38A (Warren County); 41A (Benton County); 44A (Clinton County); 45A (Boone County); 46A (Jennings County); 47A (Jefferson County); 48A (Scott County); 49A (Clark County); 50A (Floyd County); 57A (Noble County); 58A (DeKalb County); 59A (Allen County);

60A (Whitley County); 61A (Kosciusko County); 62A (Elkhart County); 63A (St. Joseph County); 66A (Cass County); 68A (Starke County); 72A (Newton County); 73A (Lake County); 78 and 78A (Adams County); 80 and 80A (Blackford County); 85A (Ohio County); 86A (Dearborn County); 87A (Ripley County); 88A (Franklin County); 89A (Union County); 90A (Fayette County); 91A (Wayne County); 92A (Randolph County); 93A (Henry County); 94A (Hancock County); 95A (Decatur County); and 100A (Tipton County).

Special Reports

Harper, Denver, 1985, Coal mining in Vigo County, Indiana: Special Report 34, 67 pages, 49 figures, 1 table.

Harper, Denver, 1985, The development of surface coal mining in Indiana: Special Report 35, 54 pages, 33 figures.

A bedrock geologic map of Indiana in the form of a multicolored post card was also printed.

Mineral Production in Indiana*

	1984		1985	
	<u>Quantity</u>	<u>Value</u>	<u>Quantity</u>	<u>Value</u>
Coal	36,055,649 tons	\$ 900,670,112	32,094,306 tons	\$ 673,980,426
Petroleum	5,394,147 bbls	153,247,716	5,167,735 bbls	138,048,000
Limestone, crushed	26,854,960 tons	89,191,176	23,386,847 tons	81,123,144
Sand and Gravel**	15,080,441 tons	44,363,818	18,782,000 tons	57,009,000
Limestone, dimension	2,065,444 cu. ft.	8,236,384	2,596,476 cu. ft.	20,185,919
Clay and Shale	682,171 tons	1,723,047	739,711 tons	2,776,446
Natural Gas	394,416,000 cu. ft.	1,332,000	394,000,000 cu. ft.	1,332,000
Undistributed (includes gypsum, marl, peat, and whetstone for 1984; gypsum, lime, and peat for 1985)	XX	8,643,164	XX	44,872,253
TOTAL	XX	\$1,207,407,417	XX	\$1,019,327,188
Value added for additional processing of dimension limestone, and manufacture of clay products and cement***				

* prepared in cooperation with the U.S. Bureau of Mines

** estimate

*** figures unavailable for 1985

XX not applicable

STATISTICAL SUMMARY

Item	* CIM	DP	ES	GCS	GLS	GPS	PTS	PBS	Totals
Area mapped (sq. mi.).....	500								500
Attendance at professional meetings.....	36				17				53
Brightness measurements on limestone and dolomite.....	10								10
Camera copy projects prepared.....	1,976								1,976
Conferences with visitors to the Survey.....	242		200		391				783
Core described (ft.).....	2,342								2,342
Cores (wells).....							18		18
Environmental questionnaires.....			45		172				217
Exhibits installed for special occasions.....			2						2
Feet of cores gamma-ray logged.....					23,283				23,283
Feet of holes augered.....					45				45
Feet of well cuttings represented on strips.....							321,975		321,975
Field trips (total)									
In connection with conferences.....	3								3
Educational.....	4		6		2				12
Industrial									
State Agency									
Identification of specimens (rock, mineral, and fossil).....			50		20				70
Information packets mailed.....			161						161

Item	CIM	DP	ES	GCS	GLS	GPS	PTS	PBS	Totals
Joint orientation measurements.....	623								623
Letters incoming.....	652		188		632		430	5,083	6,797
Letters outgoing.....	393		165		658		213	1,330	2,759
Man days of field work.....	188		42		351		137		718
Memorandum reports.....					3				3
Mineralogic analyses.....	82								82
Moisture analyses.....									0
News releases.....	3		3						6
News releases, newsletters, exhibits, etc. edited.....								18	18
Number of holes augered.....					4				4
Number of holes gamma-ray logged.....					132				132
Outside publications edited.....								57	57
Papers and posters presented at professional meetings.....	5				8		8		21
Papers reviewed.....	14		3						17
Photographic prints.....		1,274							1,274
Photomicrographs.....		20							20
Projects completed.....	13		1		3		1		18
Projects in progress.....	30		3		12		5		50

Item	CIM	DP	ES	GCS	GLS	GPS	PTS	PBS	Totals
Public lectures.....	8.....		45.....		25.....				78
Publication announcements mailed.....								924.....	924
Publications lists issued (new).....								5,597...	5,597
Published maps sold.....								13,575..	13,575
Published maps									
Coal Maps.....								6.....	6
Miscellaneous Maps (new).....								3.....	3
Miscellaneous Maps (reprinted).....								1.....	1
Petroleum Exploration Maps.....								77.....	77
(revised)									
Petroleum Exploration Maps.....								52.....	52
(changed without revision)									
Publications office customers.....								5,026...	5,026
Published reports									
Directories.....								3.....	3
Mineral Economic Series.....								1.....	1
Occasional Papers.....								2.....	2
Special Reports.....								2.....	2
Published reports sold.....								5,597...	5,597
Reproduction-logs.....								\$20,746.....	\$20,746
Reproduction-Xerox.....								\$3,207.....	\$3,207
Rock analyses (magnetic, mineralogical, textural, physical).....								1,466.....	1,466

*Note: CIM is the Coal and Industrial Minerals Section; DP is the Drafting and Photography Section; ES is the Educational Services Section; GCS is the Geochemistry Section; GLS is Geology Section; GPS is the Geophysics Section; PTS is the Petroleum Section; PBS is the Publications Section

**Totals include figures for motor-pool vehicles