FALL 1981

Ohio Geology Newsletter

Division of Geological Survey

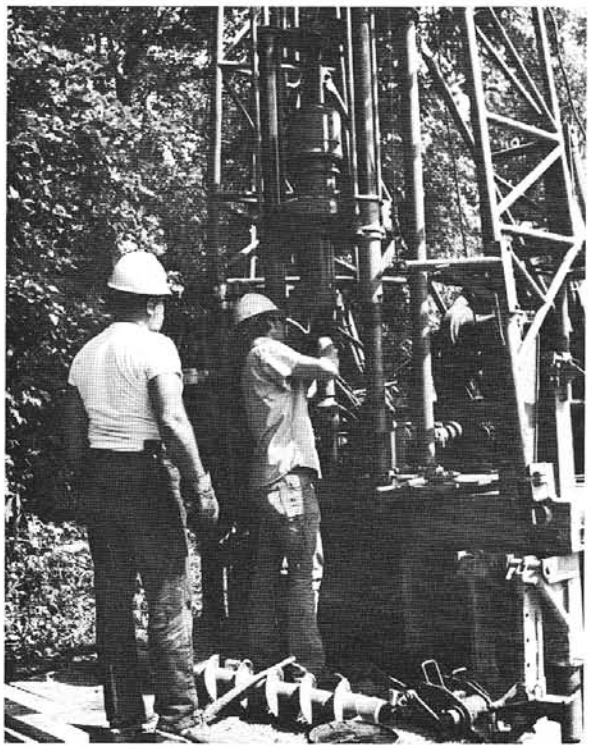
SURVEY BEGINS CORING PROGRAM WITH NEW RIG

In May 1981 the Survey finally received its long-awaited truck-mounted coring rig. The rig, a custom-built B-61 Pacemaker manufactured by Mobile Drilling Company, Inc., of Indianapolis, Indiana, has a maximum coring depth of nearly 3,000 feet. The rig and support equipment, including two trucks, were purchased through federal reimbursement funds.

The acquisition of this equipment considerably increases the data-gathering capability of the Survey and permits accurate assessment of subsurface mineral resources throughout the state. Such investigations are a principal function of the Survey. With the acquisition of the core rig, we will at last be able to explore some of the many poorly known aspects of Ohio geology. Numerous mineral resource studies and stratigraphic problems are potential targets for detailed examination.

Survey geologist David A. Hodges is in charge of the coring rig and has done an admirable job in getting the equipment on line. Driller is Michael J. Mitchell and John L. Sullivan is assistant driller. In addition to this crew, assigned full-time to the rig, a project geologist is in charge of siting holes and logging core for each particular study.

Survey coring rig in Jackson County.



Driller Mike Mitchell (right) and assistant driller John Sullivan (left) setting casing.

The initial coring project was begun in late May 1981 and was recently completed. This investigation, under the direction of project geologist Clark L. Scheerens, consisted of 11 holes drilled in search of the Sharon (No. 1) and Quakertown (No. 2) coals in the Jackson and Wellston fields of Jackson and Vinton Counties in southern Ohio. Data acquired from this project will be used as part of Scheerens' studies of the Sharon and Quakertown coals. Results of these investigations will be published by the Survey as soon as they are completed.

Numerous additional coring investigations have been proposed by Survey staff and include investigation of high-calcium limestone resources in southwestern Ohio, investigation of sulfide mineralization and its association with structural features along the Cincinnati arch, and investigation of buried valleys and preglacial drainage patterns in northeastern Ohio. Numerous proposals to evaluate coal resources and investigate stratigraphic problems are being considered for future core studies.

Cores are being stored in Survey warehouse facilities in Columbus. These cores and the information derived from them will constitute valuable reference material in regard to mineral resources and

continued on next page

ODNR
Ohio Department of Natural Resources
James A. Rhodes, Governor • Robert W. Teater, Director • Horace R. Collins, Chief

Chief's corner by Horace R. Collins

There has been considerable interest raised in the past few months over reports that a major petroleum company has been leasing property in central Ohio for the development of a shale-oil industry. Most of us have read newspaper and magazine articles on the great shale-oil deposits of the western United States. Few people realize, however, that Ohio also has large deposits of shale that will yield oil when retorted. These shale units (Ohio Shale of Late Devonian age and Sunbury Shale of Early Mississippian age) contain organic material that will, upon distillation, yield oil and gas. The yield of Ohio oil shales is estimated to be about 10 to 20 gallons of oil per ton of shale. It has also been reported that shales of the type occurring in Ohio can yield slightly over 1,000 cubic feet of high Btu gas per ton of shale. The fact that Ohio has several thousand square miles underlain by shales that could be defined as gas and oil shales and the implications for a synthetic-fuel industry based on these shales could be staggering.

The development of a synthetic-fuel industry in central Ohio could be a boon to the state. There are, however, many aspects of such an industry that will need careful study. Special consideration and planning must be given to reclamation of the land. Current reclamation laws applicable to coal mining do not apply to the surface mining of shale, and existing reclamation laws for shale are not adequate to deal with shale mining on the scale needed to support a synthetic-fuel plant. Much of the area being considered for shale development is prime agricultural land. Ohio has demonstrated that coal can be stripped and the land subsequently reclaimed—we must do as much for our prime farm lands.

Ground water is another critical resource that could be endangered by surface mining. The shale units being considered for development along with other rock units and glacial overburden are important sources of water for individual farms and households. Disturbance of these units by the mining process could permanently damage ground-water supplies.

My purpose in writing this column is to point out that there are both advantages and potential problems to the development of a shale-oil industry in central Ohio. The development of such an industry will require careful planning and cooperation between industry, governmental agencies at all levels, and private citizens to insure that the needs of all parties are assured and that our land and resources are wisely used.

continued from page 1

stratigraphy. It is premature to predict discoveries of economically valuable mineral resources, but such discoveries seem inevitable in light of the scanty subsurface information currently available over much of the state. Filling in these gaps will permit a much more accurate assessment of the state's mineral resources and, in the long run, provide necessary information for both short- and long-range decisions by industry and government. Future issues of the newsletter will include progress reports of Survey coring activities.

OHIO GEOLOGY

A newsletter published quarterly by the Ohio Department of Natural Resources, Division of Geological Survey, Fountain Square, Columbus, Ohio 43224.

Editor: Michael C. Hansen
Assistant editor: Karen J. Van Buskirk
Secretary: Donna M. Swartz
Layout and design: Philip J. Celnar
Phototypist: Jean M. Lesher

News items, notices of meetings, etc. should be addressed to the attention of the editor. Change of address and new subscriptions should be addressed to the attention of the secretary.

SUBSURFACE ACTIVITY

The Division of Geological Survey is the principal repository of subsurface geologic information for Ohio. The Subsurface Geology Section maintains a permanent file of well records and a set of oil and gas development maps which are brought up to date weekly. In addition, the Section keeps an open file of geophysical logs and a library of well cuttings and cores for examination. Records available for study include nearly 150,000 well cards, 1,100 oil and gas maps, 25,000 borehole geophysical logs, and 3,600 well-cutting suites. Copies of the records and maps may be purchased at the Fountain Square office of the Division of Geological Survey.

Ohio's recent flurry of drilling for gas and oil is reflected in the feverish activity at the Division of Geological Survey. A record amount of material is being received by the Subsurface Geology Section. A total of 7,900 drilling permits, 3,562 completion reports, and 2,986 borehole geophysical logs were processed and filed in 1980. The pace for 1981 is even greater, with 4,323 drilling permits, 2,078 completion reports, and 2,025 borehole geophysical logs having been received through July. Consequently, there also has been an unprecedented demand for this information. The Subsurface Geology Section sold 34,860 maps, 120,874 well cards, and 47,322 microfilm copies of borehole geophysical logs during 1980. Through the first 6 months of 1981 nearly 25,000 maps, 111,000 well cards, and 46,000 copies of borehole geophysical logs have been sold.

The professional staff of the Subsurface Geology Section uses the information to prepare maps, cross sections, diagrams, and geologic reports detailing subsurface conditions in Ohio. The numerous reports that have been published are cataloged in the List of Publications of the Division of Geological Survey. Recently, Report of Investigations 75, *The subsurface Silurian-Devonian "Big Lime" of Ohio,* was reprinted to meet continuing demand. RI 75 consists of a structure map, an isopach map, and well-data tables. The "Big Lime," as it is known to drillers, underlies all of eastern Ohio and is an important stratigraphic marker and drilling reference. RI 75 is available from the Survey for $8.02, including tax and handling.

The Subsurface Geology Section has recently been involved in the Eastern Gas Shales Project sponsored by the U.S. Department of Energy. The purpose of this project is to determine the magnitude of Devonian shale gas resources and

to increase gas production from the shale. Work on the project includes preparing stratigraphic cross sections and structure, isopach, and isolith maps which show the character of the Devonian shale in eastern Ohio. In addition, a gas-monitoring program was undertaken to identify zones of potential production in the Devonian shale. Six cross sections and four isopach maps have been published to date. The remaining maps and the final report will be published next year. The Eastern Gas Shales Project publications are available through the Morgantown Energy Technology Center (P.O. Box 880, Morgantown, WV 26505).

—J. D. Gray
Head, Subsurface Geology Section

ABANDONED UNDERGROUND MINES PROJECT

The abandoned underground mines project is an effort to show the extent of all abandoned underground mines in Ohio on 7½-minute topographic quadrangle maps. Funded by a grant from the U.S. Department of Interior, Office of Surface Mining Reclamation and Enforcement, this project was started in 1979 and is expected to be completed late this year. Although coal was the predominant commodity in the mined-out areas, clay, limestone, iron ore, and sandstone also were mined.

The basic source for this work is the abandoned-mine-map file of the Ohio Department of Industrial Relations, Division of Mines. These maps were reduced photographically, initially to 1:4,800 (1 inch equals 400 feet) then to 1:24,000 (1 inch equals 2,000 feet), which corresponds to the scale of the U.S. Geological Survey 7½-minute map series. The 1:24,000 reduction was then used to locate and outline the extent of each mine on mylar bases (black and white) of the topographic map. Each 1:24,000 quadrangle map shows mine outlines, mine identification numbers, relation of the mines to drainage, and the types and locations of mine entries and air or pumping shafts. Paper copies can be made from the mylar maps at a cost of $3.00 per copy.

A considerable number of quadrangle maps is currently available. Coverage is complete for the following counties: Athens, Carroll, Columbiana, Gallia, Guernsey, Hocking, Holmes, Jackson, Lawrence, Mahoning, Medina, Meigs, Morgan, Noble, Portage, Scioto, Stark, Summit, Trumbull, Washington, and Wayne.

A list of the mines by county and township also is being prepared. This listing identifies the mine by number and gives pertinent data such as mine name, operator, date abandoned or last surveyed, and, if known, the identification of the stratum mined and its elevation.

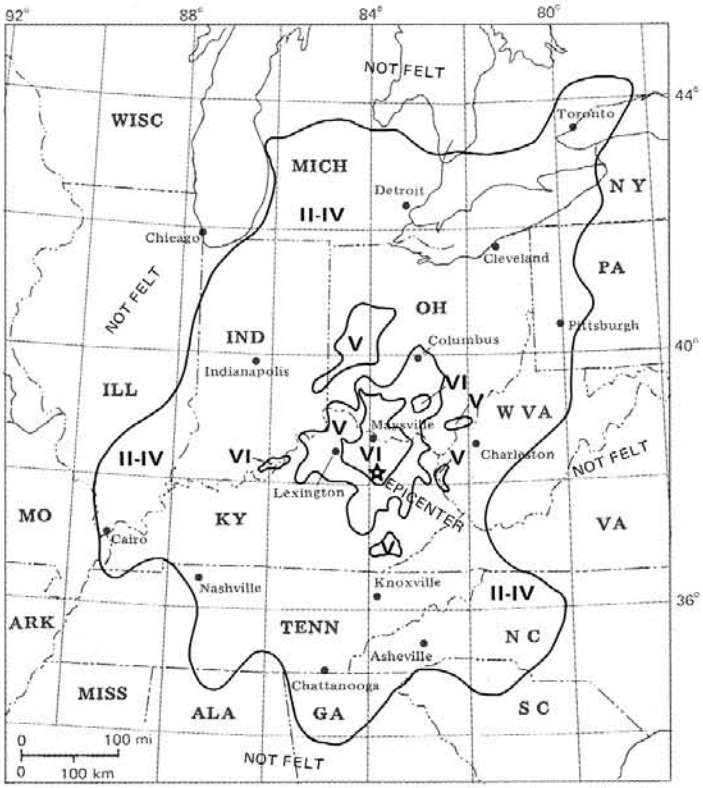
—Richard M. DeLong
Regional Geology Section

ADDITIONAL DATA FROM THE 1980 NORTHERN KENTUCKY EARTHQUAKE

The earthquake of July 27, 1980, centered in northeastern Kentucky near the community of Sharpsburg, has been the most extensively studied seismic event in the north-central United States. The last issue of the newsletter (Summer 1981) presented preliminary findings relating to this event. Additional data have now become available from two U.S. Geological Survey preliminary reports, Open-File Report 80-1242, by M. G. Hopper and B. G. Reagor (1980), and Open-File Report 81-198, by B. G. Reagor, C. W. Stover, and M. G. Hopper (1981).

The earthquake, which was felt over an area of 600,000 sq. km, was assigned the following data:

Origin time:	18 52 21.8 UTC (2:52 p.m. Eastern Daylight Time)
Latitude:	38.174°N
Longitude:	83.907°W
Depth:	8 km
Magnitude:	5.2 mb (body wave), 4.7 MS (surface wave)
Maximum Modified Mercalli intensity:	VII, Maysville, Kentucky



Generalized isoseismal map of the northern Kentucky earthquake of July 27, 1980 (modified from Reagor, Stover, and Hopper, 1981).

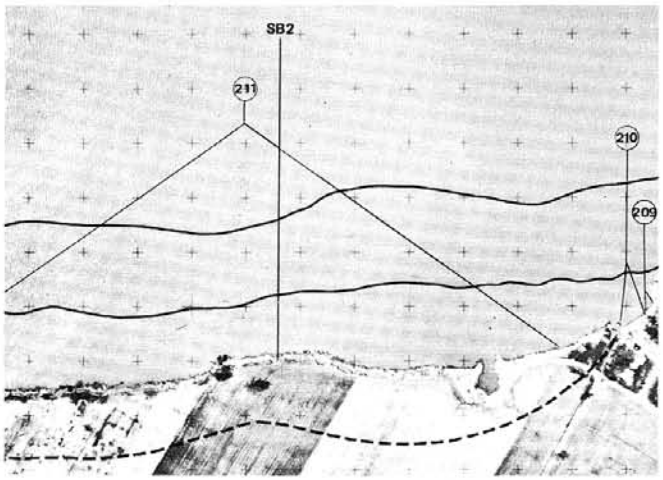
Questionnaires were distributed by the U.S. Geological Survey to postmasters within a 700-km radius of the epicenter in order to assess the distribution of intensities during the earthquake. In addition, on-site inspections for damages were conducted by U.S. Geological Survey personnel and individuals from other institutions in more than 100 communities. The result of these investigations is the accompanying isoseismal map, which demonstrates what was immediately apparent from media reports—the earthquake of July 27, 1980, was felt over a wide area. It is interesting to note that many of the higher intensities associated with the shock were concentrated along river valleys, areas commonly associated with thick alluvial sediments.

Reagor, Stover, and Hopper (1981) noted that the ground shaking, estimated to have had a duration of 15-45 seconds, caused widespread damage at the relatively low Modified Mercalli intensity of VI. In almost all cases, however, the observed damages in most areas consisted of cracking and displacement of bricks in chimneys. Inspection revealed that the majority of these chimneys were on older homes and the mortar between the bricks was weak or nearly completely weathered away. New, well-built chimneys in the same area as damaged ones appeared to have survived the shock with no damage.

As a final comment on the July 27, 1980, earthquake, it should be noted that if instrumental locations had been unavailable the epicenter of this event, based upon observed intensities, would have been placed at Maysville, Kentucky—about 50 km north of the actual epicenter. Information such as this points out the need for caution in assessing historic seismicity with only noninstrumental locations as a guide.

For those interested in locations and other data pertaining to Ohio earthquakes the U.S. Geological Survey has available Miscellaneous Field Studies Map MF 1142, *Seismicity map of the State of Ohio,* compiled by C. W. Stover, B. G. Reagor, and S. T. Algermissen (1979). This map is available from the Branch of Distribution, U.S. Geological Survey, 1200 South Eads Street, Arlington, VA 22202. Cost is 75 cents.

LAKE ERIE SHORE STUDIES



Upper Sandusky Bay shoreline with historic and projected 2010 recession lines.

The Survey recently published the third in a series of seven reports on shore erosion and flooding along the Lake Erie shore of Ohio. Report of Investigations 115, *Lake Erie shore erosion and flooding, Erie and Sandusky Counties, Ohio: setting, processes, and recession rates from 1877 to 1973,* by Charles H. Carter and Donald E. Guy, Jr., joins similar reports for Lake County (RI 99) and Lucas County (RI 107). In this report are data, collected during field studies in the 1970's, on the thickness and size of beach sand, the distribution of nearshore sediment, shore stratigraphy, and shore structures. In addition, data on land use, beaches, shore-protection structures, and recession (bluff)-line position were compiled from 1870's maps and from 1930's and 1973 aerial photographs. Recession rates were mapped for two periods: 1870's to 1930's and 1930's to 1973. Variation in rates along the shore of Erie and Sandusky Counties and changes in rates through time are related to changes in the physical setting and physical processes. A special feature of the report is black-and-white aerial photographs (scale 1:4,800, or 1 inch equals 400 feet), taken in 1973, on which the historic recession lines as well as a projected 2010 recession line have been superimposed. These lines as well as a geologic cross section of the shore also are shown separately as plates in the report. Thus, these reports provide valuable information for people interested in the lakeshore such as engineers, landowners, and planners. RI 115 is available for $11.45, including tax and handling, from the Survey.

COAL WASHABILITY STUDY

The Division of Geological Survey has begun a study of the washability of Ohio coals, under a grant from the Ohio Air Quality Development Authority. The study's purpose is twofold: (1) to assemble washability data for a broad range of Ohio coals, represented by samples from working mines throughout the coal region of Ohio, and (2) to develop a petrographic technique for the rapid determination of the washability of a coal.

Washing is the process by which sulfide minerals, principally pyrite, and ash are removed from coal in order to produce a cleaner fuel. In combination with stack scrubbers and other pollution-control devices, coal washing helps Ohio's high-sulfur coals meet air-quality standards. Presently, the only way to determine a coal's washability is to run one or more large samples (at least several hundred pounds) through a lab-scale simulation at an in-house or commercial testing lab, a costly commitment for producers and consumers.

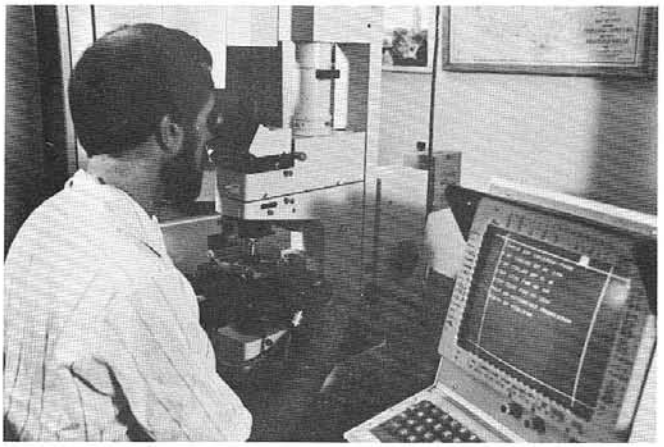
Most commercial washing facilities use some type of specific gravity process to separate out the undesirable minerals from the coal. The Survey coal washability study used heavy-media separation techniques in its lab-scale simulation of commercial processes. The data produced by the lab simulation indicate how much sulfur and ash can be removed from a given coal by washing, a very important economic consideration for coal producers and coal consumers.

George Botoman skimming the floating coal particles for transfer to the next liquid in the series.

At each sampling site, a 200-pound channel sample (gathered across the entire coal seam to represent the average characteristics of the coal) was collected in the field by geologist George Botoman. These samples were then subjected to crushing, sieving, and splitting into several subsamples. A $^3/_8$ by #30 sample split (crushed finer than $^3/_8$ inch with the material finer than #30 screen removed by sieving) was added to a series of heavy organic liquids of given densities. The particles of coal containing large amounts of pyrite and ash sink, owing to their greater specific gravities, while the cleaner pieces of coal float and are moved to the next liquid in the series.

Chemical analyses were conducted on five specific gravity fractions as well as on the sample splits representing the entire channel sample, the $^3/_8$ by #30 sample, and the fines removed by sieving. These tests were completed in the

Geochemistry lab under the direction of David A. Stith, head of the Geochemistry Section, and included determinations of moisture, ash, total sulfur, pyritic sulfur, and Btu content. Eighty-five channel samples have been processed through the washability and chemical analysis portion of the study, generating an ample body of data for use in the petrographic portion of the study.



Dick Carlton adjusting microscope before beginning the automatic size-distribution analysis.

Another set of sample splits from each channel sample went to the Regional Geology lab for petrographic analysis by geologist Richard W. Carlton. Each sample split was mixed with epoxy, formed into a cylindrical briquet, and polished. The briquets are analyzed under a Leitz Orthoplan-Pol/MPV 2 microscope, which is tied into a computerized Leitz T.A.S. automatic-image-analysis system. A photometer also is mounted on the microscope so that standard coal reflectance studies can be performed semi-automatically. This highly versatile laboratory setup is probably the first of its kind to be used for steam-coal petrography.

The microscope has an automatic stage which makes possible the systematic scanning of the polished coal-briquet surface. For each field of view the image analyzer can measure the areas of substances having different gray levels. For example, it can routinely distinguish between pyrite particles, the epoxy binder, and vitrinite macerals. In one program the image analyzer counts the pyrite particles and records information on the size of each particle, then prints a graph of the size distribution of the pyrite grains found in the coal sample.

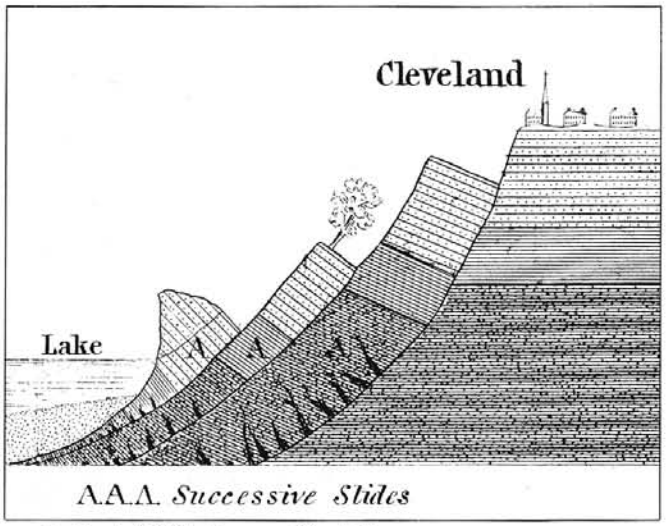
A combination of characteristics of a coal determines how much pyrite and ash can be removed by washing. These characteristics include the size, shape, and size distribution of the pyrite particles as well as the proportions of organic constitutents in the coal. Petrographic data on these characteristics is being related to the washability data in hopes of developing a technique to determine the washability of coals petrographically. If successfully developed, the coal-washability petrographic technique could provide an estimate of the amount of sulfur reduction to be obtained by washing and also indicate the optimum washing conditions.

GLACIAL GEOLOGY OF LAKE COUNTY

George W. White's report on the *Glacial geology of Lake County, Ohio* (Report of Investigations 117), focuses on the surface form and stratigraphy of the glacial deposits in this northeastern Ohio county. The 20-page text describes the physiographic provinces represented in Lake County, the geomorphology of its glacial deposits, the history of the glacial tills, the mineral resources associated with the glacial deposits, and the geological constraints on land-use planning in the county.

A color map at a scale of 1:62,500 (1 inch equals 1 mile) accompanies the text and details surface deposits as well as bedrock contours. RI 117 is available for $4.01, which includes tax and handling, from the Survey.

W. W. MATHER'S OBSERVATIONS ON LANDSLIDES, 1838



Mather's (1838) diagram of landslides.

A recent paper by George W. White and Robert F. Legget in the Canadian Geotechnical Journal (1981, v. 18, p. 294-296) points out that Ohio's first State Geologist, William W. Mather, made perhaps the earliest observation of curved surfaces of failure on landslips. Mather's observation was made during his studies of erosion along the southern shore of Lake Erie at Cleveland in 1837. Mather also noted the littoral drift along the Lake Erie shore and suggested the use of "groynes" as a means of shore protection—a method that still remains important.

Mather's insights were published in the First Annual Report of the Geological Survey of Ohio (1838) and were probably made in conjunction with Charles Whittlesey, topographer with the first Survey and resident of Cleveland. Whittlesey had intimate familiarity with the geology of northeastern Ohio and prepared the plate (see accompanying diagram) that was part of Mather's report.

Mather also described the influence of land springs in bluff retreat by their slow removal of fine material and undermining the slope (a process now known as piping). White and Legget point out that Mather's training at West Point probably included engineering courses that dealt with slope failures in excavations for fortifications; it is probable, therefore, that he had previous familiarity with failure of earth materials.

Studies of shore erosion, following the precedent of the first Survey (1837-1838), continue under the direction of Dr. Charles H. Carter, head of the Lake Erie Section of the Division of Geological Survey. Extensive studies of erosion along the Ohio shore of Lake Erie have resulted in a number of publications pertaining to this problem. Titles and costs of

these reports can be found in the List of Publications of the Division of Geological Survey or in a special compendium of Survey shore erosion reports entitled "Lake Erie area publications and open file maps." Either list is available free of charge from the Survey.

SURVEY STAFF NOTES

George Botoman

Inaleigh Johnson

Inaleigh Johnson is a Public Inquiries Assistant with the Public Service Section. Her duties include answering mail and phone inquiries and assisting customers at the Publications Desk. "I love the contact with people," she says. She started working for the State of Ohio in 1962 in the Department of Taxation and came to the Survey in 1977. Inaleigh has an unusual collection of madonnas from all over the world including one made from seashells. She hopes to pass this interest on to her daughter.

George Botoman is a geologist with the Geochemistry Section of the Survey and is currently involved with the sampling and analysis of Ohio coal for the washability study being conducted by the Survey. His particular area of interest and research is sulfide mineralization in northwest Ohio. George came to the Survey in 1973 after completing requirements for the M.S. degree at the Ohio State University. For 22 years George was a geologist and chief of exploration for ore deposits with the Rumanian Geological Survey until he and his family defected to the United States in 1970. George became a U.S. citizen in 1975. George's wife teaches Rumanian at the Ohio State University and their son recently received his M.D. degree from Johns Hopkins University.

REPRINT OF THE GEOLOGIC MAP OF OHIO NOW AVAILABLE

The wall-size version of the *Geologic map of Ohio* (scale 1:500,000, or 1 inch equals 8 miles) is once again available after being out of print for several years. The long unavailability of the map was the result of the loss of the plates from the 1965 reprint by the printer in Baltimore, Maryland. After consideration of several alternatives, most of them expensive and time consuming, it was decided that the most expedient alternative was to produce negatives by electronic color scanning of the original map. Negatives were produced using this method by the U.S. Geological Survey in Reston, Virginia.

Copies of the *Geologic map of Ohio* are available from the Survey for $1.15, including tax and handling.

OHIO PLACES

Question: What do Quickbum Hollow, Toots Crossroads, Stark Patent Bottom, Lickskillet Run, and Fort Fizzle all have in common?

Answer: They are all place names of southeastern Ohio recorded in the directory recently published by the Division of Geological Survey.

The directory is designed to help locate the cultural and natural features shown on U.S. Geological Survey 7.5-minute topographic maps. These maps record many place names of interest to the geologist and the genealogist, such as streams, ridges, hills, cliffs, waterfalls, parks, schools, churches, cemeteries, and villages, as well as other natural and cultural features.

The quadrangle map name is given for each place name, and place names are listed alphabetically by county for quick reference. The counties included in this directory are: Athens, Belmont, Carroll, Coshocton, Guernsey, Harrison, Hocking, Holmes, Jefferson, Meigs, Monroe, Morgan, Muskingum, Noble, Perry, Tuscarawas, and Washington.

Information Circular 49, *Place names directory: southeast Ohio,* is available for $1.74, which includes tax and handling, from the Survey. A similar publication, Information Circular 45, *Place names directory: northeast Ohio,* also is available from the Survey for $1.15. Counties included in IC 45 are: Ashtabula, Columbiana, Cuyahoga, Geauga, Lake, Lorain, Mahoning, Medina, Portage, Stark, Summit, Trumbull, and Wayne.

OHIO'S DEEP COAL RESOURCES

The discovery by Survey geologists of 8.6 billion tons of coal resources, including 1.1 billion tons of recoverable reserves, is detailed in Report of Investigations 116, *Investigation of the deep coal resources of portions of Belmont, Guernsey, Monroe, Noble, and Washington Counties, Ohio,* recently published by the Survey.

Thirty-two cores were drilled, many to depths of 1,000 feet, into the largely unexplored deep portions of the coal measures. The cores verified the presence of sizeable deposits of Upper Freeport (No. 7), Lower Freeport (No. 6A), and Middle Kittanning (No. 6) coals.

The report includes maps of the total seam thickness and reserve thickness for the major coal seams encountered in the study. Cross sections, columnar skeletal logs, and graphic sections of the coals found in the study area as well as tables of resource estimates and chemical analyses of the core samples accompany the report. RI 116 is available for $5.45, including tax and handling, from the Survey.

CLAY AND SHALE LEAFLET

According to recent estimates by the U.S. Bureau of Mines, Ohio ranks second in the nation in production of fire clay and fourth in total production of clay and shale, commodities annually valued at over $13 million. A new Educational Leaflet prepared by staff geologist Douglas L. Crowell acquaints the reader with this mineral industry in Ohio. EL 12 gives a brief description of the geologic origins of Ohio clay and shale resources as well as the history of their production and use. A full-color geologic map shows the location of clay and shale mines in Ohio. The page-size leaflet also includes color photos of the ceramic industry and a graph of the yearly production of clay and shale in Ohio since 1876. This publication is available free of charge from the Survey.

MINING PETROLEUM FROM THE TRENTON

In a paper in the American Association of Petroleum Geologists Bulletin (1981, v. 65, p. 526-530), Ronald D. Stieglitz, formerly a geologist with the Survey, suggests that the Trenton Formation (Middle Ordovician) of northwest Ohio should be evaluated in terms of its potential for mining of petroleum. There are thought to be substantial quantities of oil remaining in this depressurized reservoir.

Stieglitz, now an associate professor at the University of Wisconsin-Green Bay, notes that the Trenton in northwest Ohio meets the three principal criteria for consideration of oil-mining operations: (1) a record of significant production, (2) relatively shallow depth, and (3) associated or underlying rock suitable for driving and supporting shafts.

The Trenton field was first commercially produced in 1884 when drilling began for natural gas. Oil was produced soon afterward and in 1896 a peak production of over 20 million barrels was reached. Production declined rapidly after that date. Cumulative production from the Ohio portion of the field is approximately 380 million barrels. The history of this field was described in detail by Orton (1888, Ohio Geological Survey Volume 6) and Bownocker (1903, Ohio Geological Survey Bulletin 1).

Estimates vary widely but most sources agree that a large portion of the original petroleum reserve of the Trenton field remains in the ground. Stieglitz points out that conventional secondary and tertiary recovery techniques have not been employed in the area because of the large number of improperly plugged and potentially leaky wells and because of the potential for movement of oil and brine into overlying ground-water aquifers if conventional repressurization were attempted.

The main production trend of the Trenton field lies less than 1,500 feet below the surface and in many areas is less than 1,200 feet below the surface. Such comparatively shallow depths and the added bonus of potentially high-quality limestone that could be marketed are viewed by Stieglitz to be positive factors in the consideration of the Trenton as a mineable source of petroleum.

LAKE ERIE SAND RESOURCES

Two large subaqueous deposits of sand and gravel suitable for beach nourishment along Ohio's Lake Erie shore were mapped and measured in a recent study conducted jointly by the U.S. Army, Corps of Engineers Coastal Engineering Research Center (CERC) and the Lake Erie Section of the Division of Geological Survey.

The Fairport Harbor deposit, which is located offshore north-northwest of the mouth of the Grand River in Lake County, is estimated to contain 134 million cubic meters (174 million cubic yards) of sand. To give some idea of its size, this deposit would form a conical pile of sand three-quarters of a mile wide and one-quarter of a mile high.

The Ohio portion of the Lorain-Vermilion deposit, located offshore from the towns of Lorain and Vermilion, has been estimated to contain 102 million cubic meters (133 million cubic yards) of sand. Only the southern portion of the Lorain-Vermilion deposit was mapped in this study; this portion is estimated to contain 32 million cubic meters (42 million cubic yards) of sand.

Both deposits include sand-grain sizes needed for use in beach replenishment and restoration projects along the Ohio shore of Lake Erie. Sand from the Lorain-Vermilion deposit has already been used by the Corps of Engineers to nourish the beach at Lakewood Park in Lorain.

Historical vignettes

Closely spaced Trenton wells in the Cygnet Oil Pool, Bloom Township, Wood County, Ohio, 1885.

The two-part study began with a seismic reflection survey along the Ohio shore of Lake Erie from Conneaut to Toledo. The Geological Survey research vessel, the *GS-1*, towed seismic reflection equipment that creates a profile representative of the bottom sediments by emitting sound waves and recording their echoes. The sound waves are reflected from the boundaries of acoustically dissimilar materials; by knowing the speeds at which the waves are transmitted through the different materials, the thicknesses of the different deposits can be determined.

The *GS-1* then retraced its course along the line of the seismic reflection study to pinpoint selected sites where core samples were to be taken to identify the deposits shown on the seismic recordings. The Corps of Engineers tugboat *Washington* towed a scow bearing a pneumatic vibratory core-drilling rig to each coring site. The vibracores were taken at the selected sites along the seismic reflection lines to provide data on the nature of the subbottom deposits and as a check of the seismic reflection interpretations.

The extensive sand deposits at Fairport Harbor and Lorain-Vermilion were crossed and recrossed by the *GS-1* and the *Washington* in order to develop detailed maps and information on these deposits. These maps and core sediment descriptions are presented in the report listed below.

The results of the study are published in CERC Miscellaneous Report No. 80-10, *Sand resources of southern Lake Erie, Conneaut to Toledo, Ohio - a seismic reflection and vibracore study,* by S. Jeffress Williams, Charles H. Carter, Edward P. Meisburger, and Jonathan A. Fuller. This publication is available from the Division of Geological Survey for $1.00, to cover postage and handling.

COAL ATLAS

The Division of Geological Survey is preparing a coal atlas to provide general information on the principal coal seams in Ohio. The areal extent of each major seam will be mapped using 28- and 42-inch thickness contours. Maps for minor seams will show the area of occurrence without a thickness designation. Each seam map also will show the combined areas of extensive strip and underground mining. The atlas will include brief narratives on the occurrence and quality of coal, history of mining, and production tonnages in Ohio.

1979 DIVISION OF MINES REPORT AVAILABLE

The Division of Mines of the Ohio Department of Industrial Relations recently published the annual report of the production statistics of Ohio's mineral industries for the calendar year 1979. The report contains information on the value and total production of coal, oil, gas, limestone, sand and gravel, salt, sandstone, shale, clay, gypsum, and peat, as well as directories of the reporting mining operations. Copies of the report can be obtained from the Division of Mines, 2323 West Fifth Avenue, P.O. Box 825, Columbus, OH 43216.

CAREERS IN GEOLOGY

The American Association of Petroleum Geologists and the American Geological Institute have published an informative brochure on *Careers in Geology*. The brochure briefly defines the study of geology and the many specialties within the discipline. The duties of a geologist, the educational requirements, and likely personal qualifications of a candidate are all covered in this detailed brochure. Also included is a sketch of the employment outlook, current salary bases, and sources of additional career-planning information. If you know someone who is considering a career in geology, have them send for this free brochure from:

American Geological Institute
5205 Leesburg Pike
Falls Church, VA 22041

STAFF CHANGES

COMINGS

J. Sue Hubbard, Geologist, Public Service Section.
Mary P. Lee, Cartographer, Technical Publications Section.
Michael J. Mitchell, Driller, Regional Geology Section.
John L. Sullivan, Assistant Driller, Regional Geology Section.
Donna M. Swartz, Technical Typist, Public Service Section.

AND GOINGS

Rodney D. Fritz, Laboratory Technician, Geochemistry Section, to Environmental Technician, Division of Oil and Gas, Columbus.
Beverly A. Leffler, Secretary, Regional Geology Section.
Rose Lehman, Technical Typist, Public Service Section, to Technical Typist, Division of Oil and Gas, Columbus.
David A. Nicklaus, Geology Technician, Subsurface Geology Section, to Surveyor, U.S. Forest Service, Sitka, Alaska.
Richard A. Struble, Assistant Chief, to Geologist, Tetratech, Inc., Columbus.
Michael S. Temple, Geologist, Public Service Section, to Environmental Technician, Division of Oil and Gas, Columbus.
Marie A. Whitenack, Cartographer, Technical Publications Section, to Cartographer, Division of Lands and Soil, Columbus.

Ohio Department of Natural Resources
Division of Geological Survey
Fountain Square, Building B
Columbus, Ohio 43224

Address Correction Requested