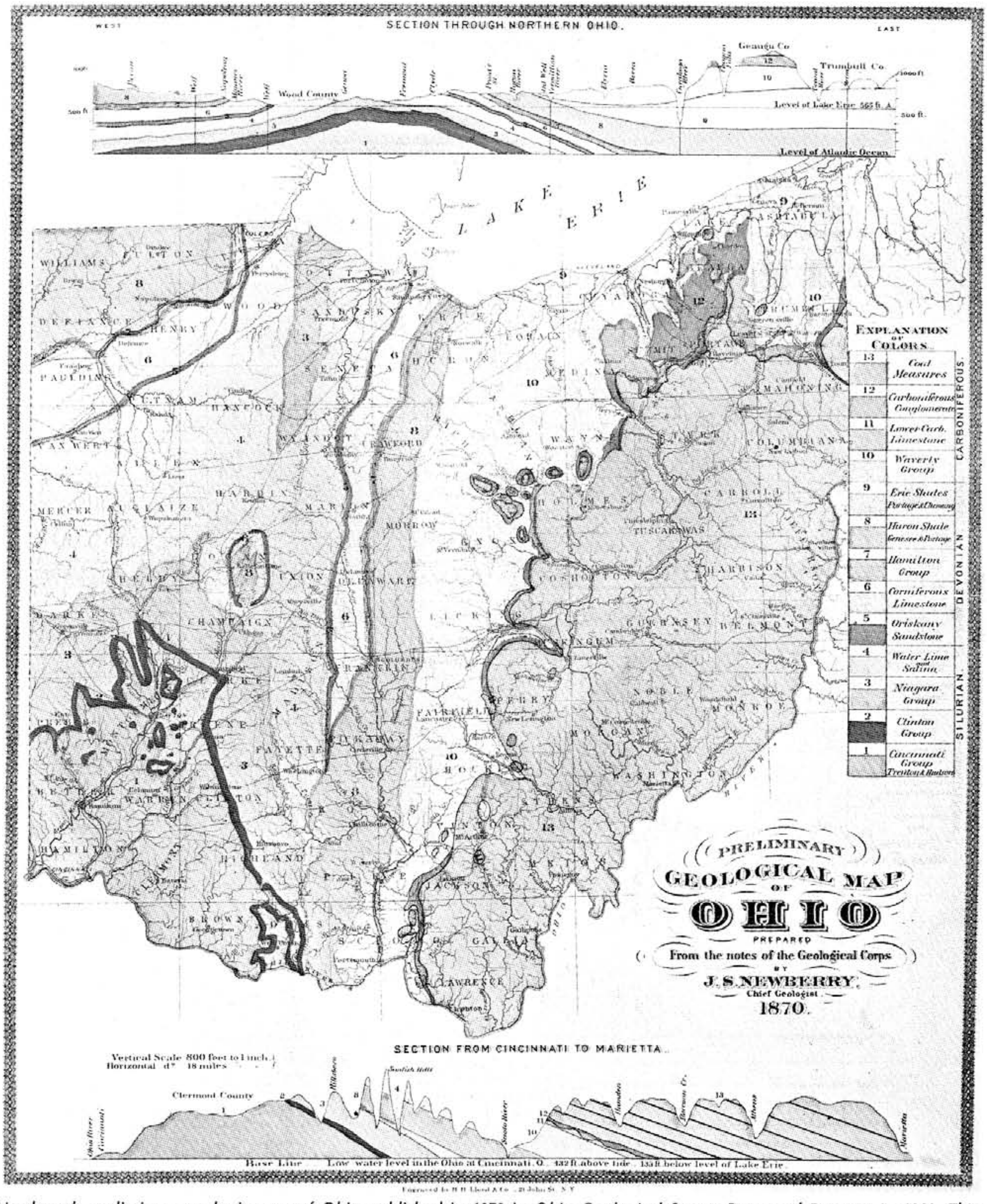
SPRING 1990

Ohio Geology Newsletter

Division of Geological Survey

HISTORY OF THE GEOLOGIC MAP OF OHIO—GEOLOGY EMERGING

by Michael C. Hansen



Newberry's preliminary geologic map of Ohio published in 1870 in Ohio Geological Survey Report of Progress in 1869. *This hand-colored map was the first official geologic map of the state.*

article continued on page 3

ODNR
OHIO DEPARTMENT OF NATURAL RESOURCES

Richard F. Celeste, Governor • Joseph J. Sommer, Director

FROM THE STATE GEOLOGIST . . . by Thomas M. Berg

THE VALUE — AND THE JOY — OF GEOLOGIC MAPPING

THE VALUE: The staff of the Ohio Division of Geological Survey and other employees of the Department of Natural Resources may be weary of hearing me carry forth on my soapbox about the importance of geologic mapping and the need to accelerate geologic mapping of the state. I have also given numerous presentations to Ohio colleges and universities and Ohio mineral-resource organizations about the importance of geologic maps. The bottom line is that *we cannot get along without these maps* if we want a balanced *and* satisfying quality of life.

The state geological surveys and the U.S. Geological Survey face a severe geologic-mapping crisis. As a nation, we have fallen behind in the production of geologic maps and have not kept up with the burgeoning need for them. Today's critical ground-water, fossil-fuel, mineral-resource, and environmental issues require accurate and up-to-date geologic information—almost always in the form of maps—to arrive at viable solutions. To compound the problem, many college and university geology departments around the nation have de-emphasized classical field geologic mapping, and there are fewer and fewer graduates in geology who know how to make geologic maps. Here are a few examples of just how important geologic maps are:

- LANDSLIDES—In 1980, the U.S. Geological Survey estimated the annual cost of landslide damage in Hamilton County, Ohio, to be $5,170,000. Citizens pay for most of this loss in insurance premiums and taxes. Geologic mapping can identify landslide-prone areas which should be avoided or specifically considered in construction design. The Division of Geological Survey recently completed geologic mapping in Hamilton County for about $89,000—less than 2 percent of the cost of annual damage in the county!
- HAZARDOUS WASTE—The cost of cleaning up Ohio's Superfund sites has been estimated at $16 million each. One estimate of the total cost for cleaning up all improperly disposed hazardous waste in Ohio is $5.8 billion. For about $2.5 million (about 1/2,000th the cost to remediate the Superfund sites), the Ohio Geological Survey could produce geologic maps which would identify areas where future hazardous-waste disposal would impose environmental risk.
- LIMESTONE RESOURCES—In eastern Ohio, where economic carbonate resources are somewhat scarce, the Mississippian-age Maxville Limestone is an important source of aggregate. It has been used for highway aggregate base, railroad ballast, crushed aggregate, concrete stone, and flux stone. It has also been used in the manufacture of portland cement. Because of its high purity and occurrence in carbonate-poor terrain, it is certain that the Maxville will be an increasingly valuable resource. Recent mapping by the Geological Survey has identified potentially 7 billion more tons of this material than was previously known to exist!
- LAND-USE PLANNING AND RESOURCE POTENTIAL—In a major metropolitan area, where close-in supplies of coarse gravel are becoming rarer and rarer, nearly 14 million tons of high-quality coarse gravel located next to an active sand and gravel producer were lost forever to a housing development. Detailed geologic mapping, carried out in conjunction with cooperative land-use planning among zoning officials, developers, and mineral producers, might have allowed much of this resource to be produced as aggregate, and then developed for housing *after* mining and reclamation.

There are hundreds of other examples of the important role geologic mapping plays in our society. Our citizens and our government policy-makers need to understand the critical importance and enormous value of detailed, up-to-date geologic maps.

THE JOY: Why in the world would a geologist want to spend a lifetime making maps? Making geologic maps is no simple process. Geologists who spend hours, days, weeks, months, and years drawing the boundaries between bedrock formations, plotting coal seams, tracking the limits of glacial deposits, delineating the distribution and configuration of deep subsurface rock units, showing the extent of fracture systems, and unraveling many other geological phenomena must derive some special satisfaction from the work, because you surely cannot get rich making geologic maps!

The making of a geologic map is an extremely complex process requiring years of university training and on-the-job experience. In essence, the geologist who engages in geologic mapping is delineating four-dimensional features on a two-dimensional surface. The geologist must not only understand how complex sedimentary, igneous, and metamorphic rock bodies intersect with intricate topographic surfaces, but must also be able to explain the entire sequence of geologic events that led to this configuration. Geologists who map sedimentary rock formations must be able to examine an outcrop or a drill-hole core and interpret the source of the original sediment, the transporting mechanism, the local depositional setting, the implications for the whole depositional basin, the degree of lateral homogeneity or heterogeneity, the history of cementation and post-depositional alteration, the history of folding, fracturing, or faulting, and the history of erosion and weathering. The geologist samples the outcrop for fossils which provide information about the age and depositional environment. The geologist also takes samples for chemical and physical laboratory analyses to assess mineral-resource potential. All of this information is carefully recorded and placed on file. And in today's growing computer environment, much of that information must be encoded in a geographic information system (GIS).

All of the field data that the geologist collects is used to prepare a geologic map. It is in this process that everything comes together. Although I relish the days in the field collecting all the data, to me the most enjoyable aspect of mapping is the making of the map itself. I can spend hours and hours without stopping, fitting everything together and coming up with the final product. It is more than just putting a puzzle together. It is sort of like solving a mystery of vast proportions. Contacts between rock units are projected beneath surficial deposits; aerial photographs and other remote-sensing images can be used to "spy" on the location of formations not accessible in the field; structures which lie hidden in the subsurface must be evaluated for their impact on formations occurring at the surface. There is no escaping it: *Making geologic maps is fun!* It is equally enjoyable and satisfying to see a wide variety of citizens make practical use of the map you have made.

Some people have an unfortunate image of geologists who make geologic maps. The image stems from the misconception that "maps are maps." There is a world of difference between a geological map and a map that shows property boundaries and the location of roads, pipelines, power lines, and other two-dimensional features. Geologists prepare maps that reflect a very sophisticated understanding of four-dimensional features. They must be able to interpret a geologic framework that extends from the surface soil to the greatest depth that a seismic survey can penetrate into the crust of the planet. They must be able to understand subtle geologic events that happened only yesterday or as much as 3,800,000,000 years ago, long before life appeared on Earth.

We enjoy making geologic maps at the Division of Geological Survey, and we are taking steps to economize and accelerate our mapping of the state. There is enough mapping to keep several generations of geologists burning the midnight oil. We will continue to serve Ohioans by making accurate geologic maps, and we hope that our government policy-makers will understand the wisdom of investing in geologic mapping.

OHIO GEOLOGY

A newsletter published quarterly by the Ohio Department Natural Resources, Division of Geological Survey, 4383 Fountain Square Drive, Columbus, Ohio 43224-1362. Telephone (614) 265-6576 (Voice) or (614) 265-6994 (TDD).

Editor: Michael C. Hansen
Secretary: Donna M. Schrappe
Phototypist: Jean M. Lesher
Pasteup artist: Edward V. Kuehnle
Halftones/Figures: Robert L. Stewart

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.

continued from page 1

A geologic map is a visual summary of the geologic knowledge of a particular area at a particular point in time. Such maps are produced at a variety of scales in order to convey different degrees of information for different purposes. A state geologic map depicts a comparatively large area; consequently, in order to be of manageable size, considerable detail must be omitted. This lack of detail precludes the use of such a map for site-specific analysis; however, such a map can convey fundamental information and portray regional geologic features. A geologic map of the state of Ohio has long been a priority. The enabling legislation for the first Geological Survey of Ohio, passed by the Ohio General Assembly on March 27, 1837, states that the Survey will "... engage the services of or employ a topographical surveyor, whose duty it shall be to make such observations and admeasurements as may be found necessary in the preparation and construction of the geological map of the state." Charles Whittlesey was employed as the topographer, but the first Survey only lasted until the end of 1838 and a geologic map of the state was not produced.

The first geologic map of the state was not published by Ohio but by New York, as part of James Hall's (State Geologist of New York, 1843-1898) geologic map of the middle and western states, included as a hand-colored, foldout map in *Geology of New York*, part 4, published in 1843. The Ohio portion of Hall's map is remarkably accurate, on a reconnaissance scale, in that it outlines the general configuration of what are now recognized as Ordovician, Silurian, Devonian, Mississippian, and Pennsylvanian-Permian rocks.

The geological corps of the first Ohio Survey had amassed, during their two-year investigation of the state, a considerable amount of data on the distribution of various rock units. It is probable, therefore, that Hall derived at least some of the information for his map from William W. Mather, first State Geologist of Ohio, who also served as geologist in charge of the First Geological District for the New York Geological Survey.

Charles Whittlesey realized the need for a separate geologic map of the state and used his observations made during the first Geological Survey of Ohio, and subsequent information, to produce several versions of such a map. The earliest of these was privately published in 1847 and the next year published in Henry Howe's first *Historical collections of Ohio*. In 1856, Whittlesey's map was reprinted by J. H.

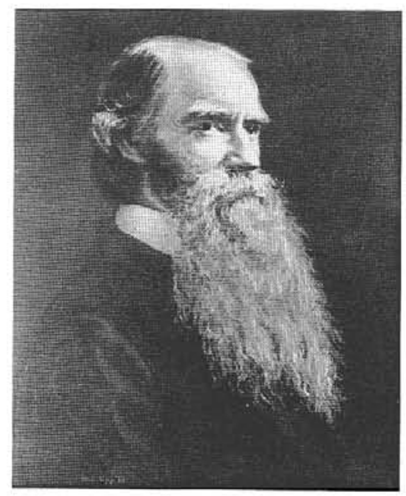
Charles Whittlesey, geologist and topographer with the first Geological Survey of Ohio (1837-1838) and author of geologic maps of Ohio (1847, 1856).

Colton & Co. of New York at a scale of 1 inch represents 12 miles.

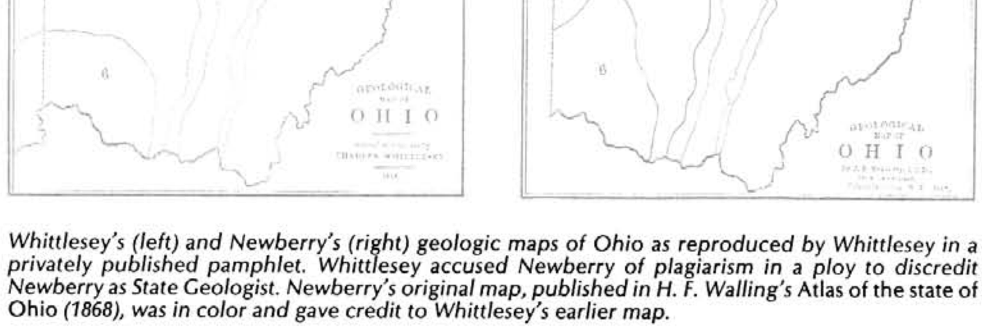
Another geologic map of the state, titled *Geological map of Ohio with adjoining portions of Pennsylvania and West Virginia*, was published in 1865 by Nelson Sayler, professor at the Mt. Auburn Ladies Institute in Cincinnati. Sayler's color map (published by E. Mendenhall Co. of Cincinnati) is at a scale of 1 inch represents 10 miles and includes an east-west cross section of the state.

Sayler's map depicts the distribution of seven geologic subdivisions which are, in general, an accurate portrayal of the bedrock geology of Ohio. The map contains the acknowledgment that it was "arranged from and according to the Ohio Geological Surveys by Nelson Sayler." This statement is intriguing because Sayler published no other work on Ohio geology. He seems to imply that he compiled the map from data collected by the Geological Survey of Ohio in 1837-1838. He may have utilized Hall's and Whittlesey's maps in his compilation, but that is not directly acknowledged.

John Strong Newberry, Second State Geologist of Ohio, published a geologic map of the state in 1868 in H. F. Walling's *Atlas of the state of Ohio*. Although Newberry's map differs in several respects from Whittlesey's 1856 map, notably in the distribution of what we now term Ordovician rocks in southwestern Ohio and Devonian rocks in northwestern Ohio, Whittlesey accused Newberry, in a privately published



John Strong Newberry, second State Geologist of Ohio (1869-1882) and author of the first official geologic maps of the state (1870, 1879).



Whittlesey's (left) and Newberry's (right) geologic maps of Ohio as reproduced by Whittlesey in a privately published pamphlet. Whittlesey accused Newberry of plagiarism in a ploy to discredit Newberry as State Geologist. Newberry's original map, published in H. F. Walling's Atlas of the state of Ohio *(1868), was in color and gave credit to Whittlesey's earlier map.*

pamphlet, of plagiarizing his map. These accusations were denied by Newberry in a letter to the *Cincinnati Commercial* on March 28, 1870. Whittlesey failed to note in his accusations that Newberry acknowledged that his map was "based upon that of Col. Charles Whittlesey." Furthermore, Whittlesey's comparative illustration (see accompanying figure) is misleading because Newberry's 1868 map was in color and at a different scale.

FIRST OFFICIAL MAP—1870

Although all of these maps portrayed, in a general way, the distribution of rocks in Ohio, none of them were "official" in the sense that they were produced under Ohio legislative authorization. Each of them could be considered a reconnaissance map. When the Geological Survey of Ohio was reactivated by the Ohio General Assembly in 1869, under the direction of Newberry, one provision of the legislation was that when the survey was completed the chief geologist would produce "... a single geological map showing by colors and other appropriate means the stratification of the rocks, the character of the soil, the localities of the beds of mineral deposits, and the character and extent of the different geological formations."

Newberry lost no time in preparing and publishing a geologic map of the state to accompany the *Report of Progress in 1869* published in 1870. Although this map, reproduced here on page 1, was also at a reconnaissance scale (1 inch represents 18 miles) and titled as a preliminary geologic map, it was much superior to previous versions and, of course, was the first official map of the state's geology.

The hand-colored Newberry map of 1870 depicted the distribution of 13 separate geologic units divided between three geologic systems—Silurian, Devonian, and Carboniferous. This map had an advantage over earlier maps because of the availability of a topographic base map of Ohio (not shown on Newberry's geologic map) that had been produced by H. F. Walling and published by H. S. Stebbins (New York, 1868).

To produce this map in a short time, Newberry divided the state into four districts: northeastern under Newberry's direction; northwestern under Herman Hertzer and G. K. Gilbert; southwestern under Edward Orton; and southeastern under E. B. Andrews. Several assistants also were assigned to each district. Each observer was to follow the outcrop of a particular unit, noting not only the contacts between rock units but also a variety of geological, economic, and archeological features "... to so thoroughly perform their work along each line of observation that it might never be necessary to go over the ground a second time." Newberry's map was accompanied by geological cross sections of northern Ohio and southern Ohio.

NEWBERRY MAP OF 1879

Newberry apparently had every intent of fulfilling the charge given to him by the legislature in 1869 of producing a detailed geological map of the state at the conclusion of the Second Geological Survey of Ohio. Through the 1870's much of the effort of the Survey had been directed towards comparatively detailed analyses of the geology of each county in the state. Consequently, considerable information on the distribution of rock units had been assembled. Newberry used these data to prepare, in 1879, a detailed state geologic map that, along with cross sections and other information, was published by the Survey as the *Geological atlas of Ohio*. This map consists of six separate sheets, each at a scale of 1 inch represents 4 miles. The distributions of 13 stratigraphic units are depicted.

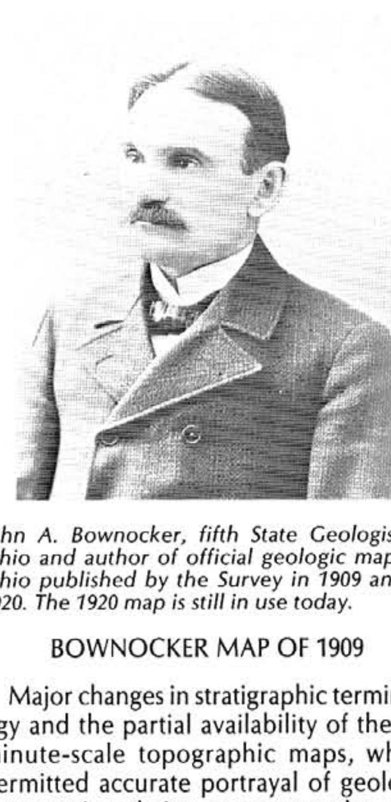
Newberry's 1879 map was the culmination of a magnificent effort put forth by a talented geological corps during only five years of intense field work. Almost all of the data used in this map had been gathered prior to the cessation of legislative appropriations to the Survey after the 1874 season. Remarkably detailed distributions of various geological units are shown on the 1879 map—this map was the foundation for subsequent statewide mapping efforts.

ORTON MAP OF 1888

Edward Orton was appointed State Geologist of Ohio in 1882 and immediately began to concentrate his efforts on summarizing the economic geology of the state. As part of these efforts, he published, in 1888, a new geologic map of the state as an accompaniment to Volume VI, *Economic geology*. This map was published at a scale of 1 inch represents 8 miles (1:500,000), a scale that has been followed in subsequent versions. Fifteen thousand copies of this map were printed.

Edward Orton, third State Geologist of Ohio (1882-1899) and author of a geologic map published by the Survey in 1888.

Orton recognized seven separate geologic units on the 1888 map—three subdivisions of the Silurian System (including rocks currently designated as Ordovician), two subdivisions of the Devonian System, the Subcarboniferous System (current Mississippian System), and the Carboniferous System (current Pennsylvanian and Permian Systems).



John A. Bownocker, fifth State Geologist of Ohio and author of official geologic maps of Ohio published by the Survey in 1909 and in 1920. The 1920 map is still in use today.

BOWNOCKER MAP OF 1909

Major changes in stratigraphic terminology and the partial availability of the 15-minute-scale topographic maps, which permitted accurate portrayal of geologic contacts in relation to topography, perhaps motivated the fifth State Geologist, John A. Bownocker, to produce a new state map in 1909. This map, at a scale of 1 inch represents 8 miles (1:500,000), was the first Ohio bedrock map to recognize the Ordovician System; which had been proposed in Britain in 1879 by Charles Lapworth but not officially accepted by the U.S. Geological Survey until 1904. The Bownocker map also used the systemic subdivisions of Carboniferous rocks into Mississippian and Pennsylvanian, which had been formally recognized as stratigraphic series by the U.S. Geological Survey in 1891 and raised to systemic rank in

1906. Eleven stratigraphic subdivisions were depicted on this map.

Bownocker's 1909 map also served as a mineral industries map as it showed the location of oil and gas fields, salt works, gypsum mines, and portland cement works. The map sold for 25 cents and 4,875 copies were printed.

The 1909 map was the first to exhibit detailed distributions of contacts between units, reflecting local topography. Without a doubt, such detail is indicative of the availability of U.S. Geological Survey 15-minute quadrangle topographic maps. The first map in the 15-minute series for Ohio was issued in 1898. By 1908, the year before publication of Bownocker's map, slightly more than half of the state had topographic-map coverage. The entire state was nearly complete by 1916.

BOWNOCKER MAP OF 1920

The availability of topographic-map coverage of the state was probably a strong motivating factor for Bownocker to produce a new state bedrock map in 1920. Comparison of this map with earlier versions clearly reveals considerable improvement in detail, obviously reflecting the projection of contacts between rock units along contour lines. On earlier maps such contacts were highly generalized. A number of work maps for the 1920 state map, drawn on 15-minute topographic quadrangle bases, are preserved in the Survey files.

Fourteen separate stratigraphic subdivisions are shown on the 1920 Bownocker map. The principal differences between the 1920 map and earlier versions, in addition to more detail, are that Ordovician rocks are subdivided into five units and Dunkard rocks in southeastern Ohio are assigned to the Permian System.

Bownocker's 1920 map, which is still the official state bedrock map, has served longer than all previous versions combined. The map was reprinted in 1929, 1947, 1965, and most recently, in 1981. The 1981 reprint, which is still available from the Survey, presented an unusual problem. The original negatives were unavailable from the printer. The Survey faced the problem of either scribing a completely new map—a lengthy process—or not having a state geologic map available. The solution to the dilemma was to prepare new negatives by an electronic-scanning method. Although this technique permitted reprinting of the map, the results were not altogether satisfactory. There was some color shift and loss of sharpness.

This map has served admirably for 70 years and reflects the excellent geologic mapping accomplished by Bownocker and his associates. Much of their interpretation of the geology of the state will not change drastically on the new map of Ohio. Certainly the new map will reflect changes in stratigraphic terminology, and a much more detailed body of information on the state's bedrock will lead to significant changes in distribution of some bedrock units, particularly in drift-covered western Ohio. A modern base will also be a welcome change on the new map.

The new state geologic map will capture only a moment in time, that is, it will be a reflection of our current knowledge of the distribution of rock units in Ohio. Any such map becomes outdated as more information accumulates. It is the Survey's hope that another seven decades will not lapse before another revised state map is published. We forge ahead in this new venture, sustained by the legacy of sound geologic work by our Survey colleagues of the last century and a half.

SURVEY RECEIVES GRANT FOR NEW STATE BEDROCK MAP

The Ohio Geological Survey recently received a $50,000 grant for calendar year 1990 from the U.S. Geological Survey as part of its COGEOMAP program. COGEOMAP is a USGS-sponsored national cooperative program to accomplish geologic mapping in the United States. The Ohio Geological Survey will use the funds as partial support to produce a new state bedrock map by 1994. It is anticipated that there will be opportunity for renewal of the grant in succeeding years.

State Geologist Thomas M. Berg has noted that Ohio's bedrock map is one of the oldest in the country, having been produced in 1920 under the direction of State Geologist John A. Bownocker. Although this map is remarkably accurate at the scale of 1:500,000 in many areas of unglaciated eastern Ohio and has served the state admirably for 70 years, it has many inaccuracies in the glaciated portion of the state, particularly in western Ohio. More detailed information on the configuration of the bedrock surface, much of which is hidden beneath thick glacial deposits, will result in many changes in the interpretation of bedrock distribution in the glaciated portion of the state. In addition, the geology will be portrayed on a new base map—on the 1920 version, railroads and electric rail lines are the principal cultural features. Stratigraphic terminology also will be brought up to modern standards and additional detail will be added.

Although the specifics of the program to produce a new state bedrock map are still in the process of refinement, plans are to produce this map on several sheets at a scale of 1:100,000, and also at other scales, including 1:250,000. There are also plans to produce a correlation chart of Ohio rocks to accompany the new map.

State Geologist Thomas M. Berg (center) met with U.S. Geological Survey officials Wayne Newell (left), Chief of the Branch of Eastern Regional Geology, and Mitch Reynolds (right), Chief of the Office of Regional Geology, in August 1989 in regard to the Ohio Geological Survey COGEOMAP proposals.

1988 REPORT ON OHIO MINERAL INDUSTRIES

The 1988 *Report on Ohio mineral industries,* compiled by Survey geologist and mineral statistician Sherry W. Lopez, is now available. The report provides production, sales, and employment statistics for all Ohio mineral industries, including coal, limestone/dolomite, sand/gravel, sandstone/conglomerate, clay, shale, gypsum, salt, and peat, plus production and value statistics for oil and gas. Alphabetical and by-county directories of coal and industrial-mineral mine operators are included, as is a map of the locations of reporting producing coal mines and all industrial-mineral mines in 1988.

The 1988 report contains an article by Dale L. Liebenthal of the Survey's Lake Erie Section on the Lake Erie sand and gravel industry in Ohio. Liebenthal, captain of the Survey research vessel, *GS-1,* discusses origins of sand and gravel deposits beneath Lake Erie, dredging vessels and methods, and history of dredging in the lake. A second article is on Ohio's Small Operator Assistance Program (SOAP) and is authored by Donald L. Povolny, SOAP Coordinator for the ODNR, Division of Reclamation. This federally funded, state-administered program assists small coal-mine operators with hydrologic and geologic studies.

Copies of the 1988 *Report on Ohio mineral industries* are available from the Survey for $6.54, including tax and mailing. The map is also available separately for $1.81, including tax and mailing.

SURVEY COMPLETES SOUTHWESTERN OHIO CORING PROJECT

Survey geologists and drilling personnel have recently completed drilling nine holes in southwestern Ohio. The main focus of this project was to provide subsurface geologic information for Lower Paleozoic bedrock mapping in Hamilton, Clermont, Brown, Warren, and Butler Counties by staff geologists Gregory A. Schumacher, Douglas L. Shrake, and E. Mac Swinford. The accompanying table lists the specific locations, cored intervals, and other information for the nine cores. All cores were drilled with the Survey's Longyear Hydro-44 drill rig by driller Michael J. Mitchell and drilling assistant Mark E. Clary.

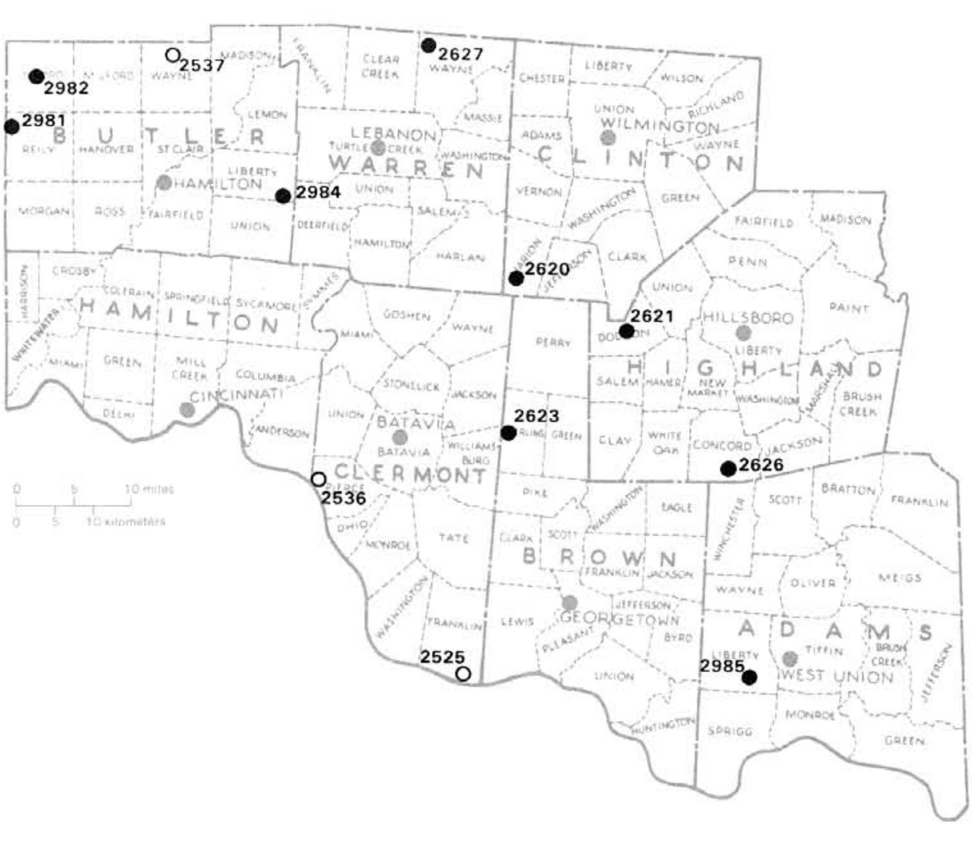
The drilling project has added essential new data to the bedrock-mapping effort by allowing geologists to study long, continuous stratigraphic sections available in the core rather than short, scattered stratigraphic sections available from natural and manmade surface exposures. The information gathered from the new cores and from cores previously drilled by the Survey in southwestern Ohio provides a means of correlating the Ordovician-age interbedded clastics and carbonates which are exposed along the Ohio River in southwestern Ohio and extend northward into the subsurface. These correlations reaffirm the stratigraphy of the units mapped at the surface, expand the area for which the stratigraphy is applicable, and allow the documentation of lateral variations within the rock units.

The lithologies in each core have been described in detail. Portions of the cores within the interbedded clastics and carbonates were measured bed-by-bed. Collecting measurements on beds as thin as 0.01 foot over intervals up to 1,000 feet thick is time consuming and tedious. More than 4,000 individual bed measurements were made on some cores. From the detailed measurements, running cumulative shale percentages were calculated for each consecutive 3-foot interval. These percentages were used to construct shale-percentage logs, which are graphic representations of the shale-percentage data. The characteristics of the shale-percentage signatures allow the geologists to trace shale-rich versus shale-poor units mapped at the surface into the subsurface.

Several of the holes were geophysically logged (see accompaning table). The geophysical logs (gamma ray and neutron) correlate well with the shale-percentage logs. Gamma ray and neutron logs also are used by the oil and gas industry as a method of characterizing rock types. Geophysical logs from oil and gas wells can be correlated to the core holes either by the shale-percentage log or the gamma ray and neutron logs. This information, when combined with detailed surface mapping, has played an important role in building an accurate framework of stratigraphic nomenclature for the rocks of southwestern Ohio.

The study of the bedrock cores has provided new information on longstanding geologic problems and has unveiled evidence of previously undocumented geologic features in southwestern Ohio. The most publicized drill hole of this project was the Warren County deep core DGS 2627 (see *Ohio Geology*, Summer 1989). Originally, the site was chosen to obtain shallow stratigraphic information for northeastern Warren County. However, it was decided to extend the core hole through the entire known sedimentary sequence and into the underlying igneous or metamorphic sequence, commonly referred to as the basement. Drilling into the basement is part of an ongoing Survey effort to develop a deep-subsurface core database for western Ohio which can be used in oil and gas exploration, environmental protection assessments (e.g., deep-well-injection permit-application reviews), and regional stratigraphic correlation. After penetrating 3,470 feet of the expected Paleozoic stratigraphic section, the drill bit encountered an unex-

Division of Geological Survey Longyear Hydro-44 core rig drilling in Warren County.



Locations of core holes drilled by the Division of Geological Survey in southwestern Ohio. Solid circles represent cores drilled during the current project. Open circles represent cores drilled during previous Survey investigations.

pected lithic sandstone unit beneath the Mount Simon Sandstone (Upper Cambrian). A total of 1,910 feet of this pre-Mount Simon sandstone, which is being formally designated the Middle Run Formation, was cored before poor drill-hole conditions forced the termination of drilling.

The presence of this previously unknown sandstone was the impetus for running an 8-mile-long, east-west seismic survey centered on the drill site. The seismic profile confirmed the presence of a previously unrecognized sedimentary basin beneath Ohio's known Paleozoic sedimentary sequence. The seismic survey was administered by Drs. Paul J. Wolfe and Benjamin H. Richard of the Department of Geological Sciences at Wright State University and was funded by several corporate and private donors.

The Warren County core hole and seismic profile have already resulted in several publications. An Ohio Geological Survey Information Circular is now in final stages of preparation. Survey geologists Douglas L. Shrake, Lawrence H. Wickstrom, and Richard W. Carlton are coauthors (along with several academic and industry researchers) of a technical paper that will soon be submitted for publication in a professional journal. The Middle Run Formation is described by Doug Shrake in an article to be published in the Ohio Journal of Science. Furthermore, the Cincinnati Arch Consortium, consisting of the Ohio, Kentucky, and Indiana Geological Surveys and several oil and gas exploration companies, has been formed to obtain funding for a comprehensive investigation of this newly discovered geologic basin.

In addition to the exciting discovery of the Middle Run Formation, project cores contain thin beds of altered volcanic ash, called bentonites or bentonitic shales. The newly discovered impure bentonites occur in the Point Pleasant Formation and the Lexington Limestone (Middle and Upper Ordovician). Bentonite beds are common in the upper portion of the Black River Group and the overlying lower portion of the Lexington Limestone, but were previously undocumented within the upper portion of the Lexington Limestone and the overlying Point Pleasant Formation.

Ash from volcanic eruptions commonly covers wide areas and is deposited almost instantaneously, over a period of days, rather than over a period of hundreds, thousands, or even millions of years, as are many beds of rock. Therefore, layers of volcanic ash are excellent stratigraphic marker beds that also represent timelines. Timelines (marker beds) which are traceable over large areas allow geologists to obtain important information on sea-floor configuration at the time of sediment deposition. In addition, minerals within the bentonite beds can sometimes be dated to reveal absolute age measurements (an actual date in years before present) of the time of deposition. Survey geologists Gregory A. Schumacher and Dr. Richard W. Carlton have identified and described the new impure bentonites and presented their findings at a recent annual meeting of the North-Central Section of the Geological Society of America. They are preparing a paper for publication documenting the newly discovered ash beds.

The cores in the northwestern portion of the study area help to define the boundaries of a geologic feature commonly referred to as the Sebree Trough. The Sebree Trough is 30 to 125 miles wide, 600 miles long, and extends from north-central Ohio southwestward through southeastern Indiana into western Kentucky. Sedimentary rocks within the Sebree Trough are generally dark-brown, black, or gray shales which separate the limestones and dolomites of the Trenton carbonate platform in northwestern Ohio from the interbedded limestones and shales of the Lexington carbonate platform in southwestern Ohio.

The highly unusual nature of the Sebree Trough sediments has resulted in a cooperative study between Survey geologists Greg Schumacher and Mac Swinford and Dr. Stig Bergström of the Department of Geology and Mineralogy of The Ohio State University. Dr. Bergström has received a $30,000 grant from the American Chemical Society to attempt to understand the nature and timing of the geologic processes which formed the Sebree Trough. As part of this cooperative effort, one core hole (2982, Butler County) has been drilled by the Survey and a second is scheduled to be drilled to provide core samples for lithologic and biostratigraphic study of the trough sediments and to support bedrock mapping in that area.

The valuable data and many discoveries made possible through the study of cores obtained in this drilling project reaffirm the utility and critical importance of the Ohio Geological Survey's core-drilling capability in examining Ohio's geology. The study of cores provides new and powerful information that gives geologists the opportunity to investigate important aspects of the geology of an area that otherwise would never be realized. This essential information permits geologists to better assess an area's geology, and thus makes these assessments more useful to land-use planners, mineral-resource explorationists, geotechnical personnel, and environmental regulators. The Survey drilling program will undoubtedly continue to be essential as we refocus the bedrock-mapping program on producing a new state bedrock geologic map by 1994.

—E. Mac Swinford
Bedrock Mapping Coordinator
Regional Geology Section

LOCATIONS, ELEVATIONS, CORED INTERVALS, AND AVAILABILITY OF GEOPHYSICAL LOGS FOR NINE CORES RECENTLY DRILLED BY THE OHIO GEOLOGICAL SURVEY IN SOUTHWESTERN OHIO AS PART OF THE BEDROCK MAPPING PROGRAM

DGS core number	County	Township	Section	Total depth (feet)	Cored interval[1]	Geophysical logs available	Surface elevation (feet)
2620	Clinton	Marion	NA	992	Oci-Obr	no	1000
2621	Highland	Dodson	NA	1008	Oci-Obr	no	1020
2623	Brown	Sterling	NA	1326	Oci-Okn	no	915
2626	Highland	Concord	NA	1762	Sbi-Owc	yes	1110
2627	Warren	Wayne	14	5380	Oci-PCmr	yes	1005
2981	Butler	Reily	18	1062	Oci-Obr	yes	1012
2982	Butler	Oxford	16	980	Oci-Obr	yes	940
2984	Butler	Liberty	7	840	Oci-Obr	yes	857
2985	Adams	Liberty	NA	560	Sb-Oci	no	900

[1]Sbi, Silurian Bisher Formation; Sb, Silurian Brassfield Formation; Oci, Ordovician Cincinnati group; Obr, Ordovician Black River Group; Owc, Ordovician Wells Creek Formation; Okn, Ordovician Knox Dolomite; PCmr, Precambrian(?) Middle Run Formation.

SURVEY CO-HOSTS USGS EASTERN CLUSTER MEETING

On March 5-7, 1990, the Ohio Geological Survey co-hosted the annual Eastern Region Cluster Meeting of state geologists from states east of the Mississippi River and representatives of the U.S. Geological Survey Geologic Division. The purpose of this meeting was to discuss cooperative state and federal programs and other areas of mutual interest.

State Geologist and Division Chief Thomas M. Berg served as a moderator of the meeting, which was held at the Deer Creek State Park lodge. Ohio Department of Natural Resources Director Joseph J.

Sommer gave a welcoming address to the group.

Numerous topics were discussed at the meeting, including the National Coastal Geology Program, the National Geologic Mapping Program, and earthquake risk in the eastern United States. Discussions were also held on radon, geographic information systems (GIS), and industrial minerals workshops.

Many Survey staff members assisted in the planning of the meeting and served as drivers to ferry attendees to and from the Columbus airport. The Eastern Region Cluster Meeting was deemed both productive and enjoyable by participants.

QUARTERLY MINERAL SALES, OCTOBER—NOVEMBER—DECEMBER 1989

compiled by Sherry W. Lopez

Commodity	Tonnage sold this quarter[1]	Number of mines reporting sales[1]	Value of tonnage sold[1] (dollars)
Coal	7,501,288	175	$252,626,198
Limestone/dolomite[2]	10,439,866	96[3]	37,414,703
Sand and gravel[2]	9,621,283	198[3]	31,651,742
Salt	1,394,741	5[4]	19,580,078
Sandstone/conglomerate[2]	307,517	13[3]	6,265,549
Clay[2]	281,478	21[3]	724,542
Shale[2]	373,344	16[3]	482,144
Gypsum[2]	59,093	1	384,105
Peat	6,938	3[3]	54,550

[1]These figures are preliminary and subject to change.
[2]*Tonnage sold* and *Value of tonnage sold* include material used for captive purposes. *Number of mines reporting sales* includes mines producing material for captive use only.
[3]Includes some mines which are producing multiple commodities.
[4]Includes solution mining.

1989 OHIO MINERAL SALES[1]

compiled by Sherry W. Lopez

Commodity	Tonnage sold in 1989[2]	Number of mines reporting sales[2]	Value of tonnage sold[2] (dollars)	Percent change of tonnage sold from 1988[2]
Coal	31,449,443	202	$1,004,282,674	-0.2
Limestone/dolomite[3]	40,308,570	104[4]	145,961,002	-11.8
Sand and gravel[3]	40,290,887	212[4]	132,996,124	-5.0
Salt	4,277,846	5[5]	49,993,325	+14.7
Sandstone/conglomerate[3]	1,591,398	24[4]	25,948,292	-11.9
Clay[3]	1,247,480	24[4]	3,184,838	+34.4
Shale[3]	1,696,537	20[4]	2,018,077	-23.2
Gypsum[3]	237,039	1	2,074,593	-1.2
Peat	34,308	3[4]	177,832	+39.6

[1]The sums of previously reported quarterly totals may not necessarily equal the annual totals reported here owing to the receipt of additional information or corrections to previously reported figures.
[2]These figures are preliminary and subject to change.
[3]*Tonnage sold* and *Value of tonnage sold* include material used for captive purposes. *Number of mines reporting sales* includes mines producing material for captive use only.
[4]Includes some mines which are producing multiple commodities.
[5]Includes solution mining.

MASTODON AT STATE FAIR

The Burning Tree mastodon (see *Ohio Geology*, Winter 1990), found near Newark in December 1989, will be a featured exhibit in the Natural Resources Area at the Ohio State Fair August 2 through 19. The skull and several other skeletal elements will be displayed in a specially designed case constructed by Ohio Department of Natural Resources carpenters. The specimen is on loan from Sherman Byers, owner of the mastodon, and Paul Hooge, director of the Licking County Archeology and Landmarks Society.

BRINE ANALYSES AVAILABLE

Trace element analyses of Ohio brines reported to be on open file in an article in the Summer 1989 issue of *Ohio Geology* have been assembled into an open-file report. Open-File Report 89-1, *Characterization of trace metals in Ohio brines—final report,* includes 94 analyses of samples collected between 1985 and 1989. This report is available from the Survey for $3.93, which includes tax and mailing.

SURVEY FAX AVAILABLE

The Survey now has FAX machines at the main office in Columbus and the Sandusky office. The Columbus number is 614-447-1918; the Sandusky number is 419-626-8767. Documents can be faxed to these numbers 24 hours a day.

Ohio Department of Natural Resources
Division of Geological Survey
4383 Fountain Square Drive
Columbus, Ohio 43224-1362

Naturally OHIO the heart of it all!

BULK RATE
U.S. POSTAGE
PAID
Columbus, OH
Permit No. 537

Address Correction Requested