

PART TWO

# The Divisions

## THE DIVISIONS



*As provided by Titles I and XV of the Ohio Revised Code, Divisions are established within the Ohio Department of Natural Resources having technical and administrative staff and authority to perform "one or more of the functions committed to" the Department and "to eliminate unnecessary duplications of effort and overlapping of functions."*

# DIVISION OF GEOLOGICAL SURVEY

Michael C. Hansen and  
Ralph J. Bernhagen

Since its inception in 1837, the Ohio Geological Survey has been the principal source of geologic information in and about Ohio. These data, gathered under the direction of eleven State Geologists, constitute more than 30,000 printed pages and numerous maps and charts describing and illustrating Ohio's geology and mineral resources. This information has, perhaps more than any other factor, been responsible for the development within the state of important industries that rely upon mineral commodities derived from Ohio's bedrock and glacial sediments.

The Division of Geological Survey is the oldest natural resources agency in the state. During the 19th Century, the Survey was responsible for investigation of the flora, fauna, soils, and agriculture of Ohio in addition to the primary function of geologic studies. Investigative activities of the Survey were sporadic in the 19th Century; major periods of activity were 1837-1838, 1869-1874, and 1882-1893. Since 1900, the Survey has been maintained on a continuous basis, and in 1949, the Geological Survey became one of the seven originally chartered divisions of the Ohio Department of Natural Resources. The Survey has therefore been inextricably linked to the development of geological investigations in Ohio. Throughout its existence, funding and staffing of the

Survey have been characteristically modest, and upon occasion, controversy and criticism have plagued Survey progress and activities. In spite of these obstacles, the Division of Geological Survey has compiled an enormous geologic database and, at times, has been the focal point for solution of stratigraphic, environmental, and other geologic problems of regional, national, and worldwide significance.

There have been four separate surveys, or "organizations," administered by the following State Geologists: First Organization, 1837-1838, William W. Mather; Second Organization, 1869-1888, John S. Newberry (1869-1882), and Edward Orton, Sr. (1882-1888); Third Organization, 1888-1900, Edward Orton, Sr.; and Fourth Organization, 1900-present, Edward Orton, Jr. (1900-1906), John A. Bownocker (1906-1928), Wilber E. Stout (1928-1946), George W. White (1946-1947), John H. Melvin (1947-1957), Ralph J. Bernhagen (1957-1968), Horace R. Collins (1968-1988), and Thomas M. Berg (1989-present). Many individuals have served the Ohio Geological Survey with distinction as full-time staff members or as unsalaried authors of important research studies. Indeed, a cursory perusal of authors of the many Survey reports yields a long list of prominent geologists.

Almost nothing survives in the files of the Survey from

Figure 5.1. William W. Mather, first State Geologist of Ohio, 1837-1838.



administrations prior to that of Wilber Stout (1929-1946). These missing documents, in toto, probably do not survive in any repository. Such pertinent historical materials that we have located in this continuing investigation include: Samuel P. Hildreth Collection and E.B. Andrews Papers, Marietta College Library, Marietta, Ohio; Charles Whittlesey Papers, Western Reserve Historical Society, Cleveland, Ohio; John Klippart Papers and Increase A. Lapham Papers, Ohio Historical Society, Columbus, Ohio; James Hall Papers, New York State Library, Albany, New York. Notably conspicuous by their absence from this list are the Mather, Newberry, and Orton, Sr. papers. Should these collections still exist and be located, they would prove of much importance to the history of Ohio geology and particularly the history of the Ohio Geological Survey.

A rather large assemblage of publications relates directly to the history of the Survey. An exhaustive list can be derived from Smyth's 1979 *Bibliography of Ohio Geology*.<sup>1</sup> Merrill's 1920 work<sup>2</sup> is the most complete summary of the Ohio Geological Survey through 1900. Biographies of individuals associated with the Survey frequently furnish pertinent information, and many of these are referenced in the 1979 paper of Hansen and Collins<sup>3</sup> from which also a major portion of this chapter is derived.

### THE MATHER SURVEY (1837-1838)

Geological investigations in Ohio prior to the establishment of a geological survey in 1837 were of a cursory and generally localized nature, conducted by individuals on a purely part-time basis at their own expense. Predictably, the overall geological framework of Ohio was poorly understood, and private exploration of and investment in mineral resources was frequently shadowed by trickery, deceit, and certainly speculation brought about by this ignorance.<sup>4,5</sup>

The beginning of the industrial revolution and the demands of an increasing population in Ohio for mineral commodities, in particular salt, coal, iron ore, and clay, prompted Governor Robert Lucas in 1835 to recommend the establishment of a geological survey of the state in his annual message to the legislature.<sup>6</sup> Undoubtedly Governor Lucas' motivation was, in part, his desire to keep Ohio

competitive with the surrounding states, many of which had established or were in the process of establishing geological surveys. It is obvious also from correspondence of Increase A. Lapham that many Ohio scientists were strongly in favor of a geological survey and conveyed their sentiments to political figures, including the governor. The legislature, acting upon Governor Lucas' suggestion, passed a resolution on 14 March 1836 establishing a committee "to report to the next legislature the best methods of obtaining a complete geological survey of the state, and an estimate of the probable cost of the same."<sup>7</sup>

The committee appointed by the legislature consisted of John L. Riddell, John Locke, Increase A. Lapham, and Samuel P. Hildreth, Chairman. Hildreth's report in 1836 to the legislature<sup>8</sup> represented a summary of the geological information then known about Ohio. The reports of Riddell and Lapham in 1837<sup>9</sup> were not included with Hildreth's report but were presented to the legislature somewhat later. These individuals conducted field work during the summer of 1836 so that a more precise direction could be given to the Survey. Hildreth's committee recommended that the geological survey consist of a principal geologist and five assistant geologists, one draftsman, and one naturalist, to be funded for salaries and travel expenses at a sum of \$12,000 per year for four years.

The Geological Survey of Ohio was authorized by legislative action on 27 March 1837 and was organized along lines similar to those suggested by Hildreth's committee. William Williams Mather (Fig. 5.1) was appointed Principal Geologist with Samuel P. Hildreth, John Locke, Caleb Briggs, Jr., Jared P. Kirtland, and Charles Whittlesey (Fig. 5.2) as assistants. J.W. Foster was added to the corps to replace Locke, who was in Europe during 1837, and after Hildreth's resignation at the end of the 1837 field season was made a permanent member.<sup>10</sup> Kirtland was to report on the topography and serve as draftsman. The other assistant geologists were to report on the geology of various parts of the state and other topics to which they were assigned.

Hildreth was by reputation and deed the most experienced geological observer in Ohio; however, he either did not secure or did not accept the appointment as Principal Geologist. Governor Vance offered the Principal Geologist

position to Hildreth, then to Kirtland<sup>11</sup>, but both reportedly declined the position and recommended Mather's appointment. Mather, who was with the Natural History Survey of New York, was 33 years of age and had little firsthand experience and familiarity with the geology of Ohio. Perhaps Hildreth's comment in the committee report to the legislature, strongly recommending establishment of a survey in Ohio, gives some insight on Mather's appointment: "That great and public spirited state, New York, ever amongst the foremost in the march of improvement, has taken up the subject with a zeal and an outlay, commensurate with so noble an object."<sup>12</sup> Political figures in Ohio possibly considered it a coup to lure one of New York's own geologists away to become Principal Geologist of Ohio. Orton in 1894 gave credence to this idea, indicating that Mather's work with the New York Survey gave him considerable prestige in Ohio.<sup>13</sup>

The Mather Survey conducted field work for the seasons of 1837 and 1838 and published results of these endeavors in two annual reports, both bearing the publication date of 1838. Legislative appropriations for the Survey were discontinued (except \$300 to catalog the mineral specimens) after publication of the Second Annual Report despite repeated attempts at passage of legislation to renew the appropriation of the Survey.<sup>14</sup> Hildreth noted that the paucity of funds in the state treasury caused by over-expenditures on the state canal system and other works was the primary reason for discontinuing the survey.<sup>15</sup> Orton in 1894 intimated that the demise of the Mather Survey may have been additionally precipitated by disillusionment among legislators with the results obtained, because of the great expectations of wealth and fortune fostered during the necessary, but perhaps overdone, initial promoting of the potential wealth to be generated by the Survey.<sup>16</sup> Other possible causes included the financial panic of 1837, local jealousies brought about by the impression that only the coal-bearing portion of the state would benefit from a geological survey, party politics, and accusations by certain legislators that members of the geological corps had used information derived from Survey activities to speculate on land and mineral resource purchases.<sup>17</sup> This latter charge was denied by Mather.<sup>18</sup> Perhaps all of these factors were

*Figure 5.2. Charles Whittlesey, one of the geologists who served under William W. Mather during the First Geological Survey of Ohio in 1837-1838 and a leading, but unsuccessful, candidate for the position of second State Geologist in 1869. Photo courtesy of the Western Reserve Historical Society.*



involved in the demise of the Mather Survey. Repeated attempts to restore the Survey appropriation to the state budget met with no success,<sup>19</sup> and a total of \$16,700 was expended for the first Survey.<sup>20</sup>

The First Annual Report<sup>21</sup> is a brief, but surprisingly accurate, reconnaissance sketch of Ohio's geology. It contains numerous astute insights from several of the assistants. Mather reported the problems of erosion of the Lake Erie shore—problems that are still a great concern and area of investigation for the Survey. Hildreth's report furnished a detailed summary of the salt industry in Ohio. The reports of Kirtland, Briggs, Whittlesey, and Foster are brief summaries of the mineral resources and stratigraphy or other responsibilities in their respective districts.

The Second Annual Report<sup>22</sup> contains considerable information gathered primarily during the field season of 1838. The future importance of mineral industries founded upon the state's abundant supplies of coal, limestone, clay, sandstone, and iron ore was foreseen. Mather predicted that coal would become the most important mineral industry of the state. Kirtland's report on the recent fauna of Ohio is a highly significant record of distribution of many animals extirpated from Ohio since pioneer days.

The report by John Locke on the southwestern district is the most extensive and is replete with abundant original observations, geological and otherwise. Locke was interested in elevations and dip of strata and was the first to recognize the existence of the Cincinnati Arch. Locke's report contains numerous diagrams depicting the stratigraphy of southwestern Ohio, a map of Fort Ancient in Warren County, and perhaps most significantly a colored geologic map of Adams County. Although this map, which included a cross section, is primitive by today's standards, it was a notable accomplishment for its day when no base maps depicting topography were available.

Whittlesey published a planimetric map of the state that has been referred to as the most accurate map of Ohio compiled in the 19th Century.<sup>23</sup> The detailed topographic map of the state suggested by Mather<sup>24</sup> was not finished before cessation of the Survey.

Perhaps the most significant accomplishment of the first Geological Survey of Ohio was the delineation of the general stratigraphic sequence in the state and the basic geological structure. From these data, more accurate assessment of the state's mineral resources was possible; and prevailing notions, such as the occurrence of coal in western Ohio, could be dispelled on the basis of firm information. The value of taxable lands in the eight counties most intensively examined by the Survey increased in value from \$5.5 million in 1835 to \$11.3 million in 1841.<sup>25</sup> Ostensibly this increase was due in part to the revelation of the mineral wealth by the Survey.

The accomplishments of the Mather Survey must be regarded highly on their own merits; however, in view of several realities these accomplishments assume greater significance:

- 1) The geology of Ohio was essentially unknown.
- 2) The Survey only lasted for a year-and-a-half.
- 3) No adequate base maps were in existence and few known elevations were tabulated.
- 4) Travel was difficult, roads were poor, and members of the Survey were regarded suspiciously by many residents.<sup>26</sup>

### THE NEWBERRY SURVEY (1869-1882)

After termination of the first Survey as a viable organization in 1838, numerous attempts were made to reactivate the Geological Survey.<sup>27</sup> These attempts failed, however, and 31 years passed before a geological survey again became a reality in Ohio. At the encouragement of Governor Rutherford B. Hayes and others, Captain Alfred Lee of Delaware County introduced legislation in 1869 calling for the establishment of a Geological Survey of Ohio.<sup>28</sup> This bill was passed in March 1869.

Nearly every prominent geologist in Ohio was consulted in the preparation of this bill; however, it is apparent that the General Assembly began with a naive opinion as to the cost, time, and results of a geological survey.<sup>29</sup> The bill called for appointment of a Principal Geologist and three

assistants, one of whom was to be responsible for an agricultural survey of the state. The survey was to be completed in three years, with reports furnished on economic geology, general geology, botany, archeology, zoology, and agriculture. Appropriations were to be \$13,900 per year for three years.

John Strong Newberry, Charles Whittlesey, Edward Orton, Sr., and E.B. Andrews were the principal candidates for the chief geologist position, and many thought that Whittlesey was the likely choice. Indeed, Whittlesey had many supporters in the legislature. He met with Governor Hayes soon before the selection was to be made and was led to believe he would become the second State Geologist of Ohio. However, the next day Newberry's appointment was announced.<sup>30</sup> Newberry (Fig. 5.3) and his selected assistants, Edward Orton, Sr., E.B. Andrews, and John Klippart, were confirmed by the Senate and field work began on 1 June 1869. Eleven local assistants also were chosen.

Whittlesey was obviously distressed over his failure to receive the appointment of chief geologist and apparently spent most of the time Newberry and his assistants were in the field in 1869 building a case against Newberry's appointment. The principal charge against Newberry was the retention of his professorship at Columbia College (New York) at \$3000 per year while serving as Principal Geologist of Ohio at \$3000 per year. Newberry, however, had informed Governor Hayes and members of the legislature of this arrangement before his confirmation. The majority party of the committee strongly deplored Newberry's appointment while retaining the position at Columbia College and stated that this circumstance was "a humiliation to the state of Ohio."

The evidence presented at the hearings conducted by the House Committee on Retrenchment consisted of several letters and oral testimony intended to be damaging to Newberry. Such topics as Newberry's legal residence (Cleveland or New York) and place of voting were discussed. Newberry's dual appointments were portrayed in the light of fraud against the state, and aspersions were cast on the political nature of Newberry's appointment. The minority party on the committee came to the defense of Newberry and the attempt at removal was thwarted,

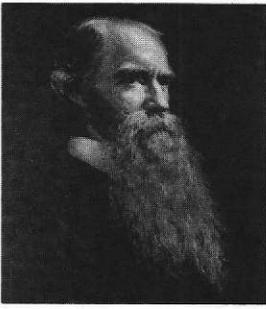


Figure 5.3. John S. Newberry, second State Geologist of Ohio, 1869-1882.

although Whittlesey continued his attacks in letters to newspapers. Newberry finally responded to Whittlesey's accusations in a lengthy letter to the *Cincinnati Commercial* on 28 March 1870. All of Whittlesey's charges were reduced to the trivial and often false nature that they were.

Newberry went on to examine Whittlesey's motives for these attacks (his loss of the Principal Geologist position) and took the opportunity to criticize severely Whittlesey's abilities as a geologist. These accusative exchanges between Whittlesey and Newberry and their respective supporters soon faded from the public forum, but the controversial beginnings of the Newberry Survey apparently generated significant polarization among influential political figures in the state. Petty criticism and political bickering were constant throughout Newberry's tenure as State Geologist of Ohio.

Newberry's plan for the Survey was to publish four volumes: the first two were to consist of two parts, geology and paleontology; the third volume was to report on economic geology; and the fourth to consider agriculture, botany, and zoology. From the beginning, the investigations and publications of the Newberry Survey were criticized for the length of time necessary to complete work, the expense, and, most importantly, the "impractical" nature of the stratigraphic and paleontologic work. In his annual reports to the legislature for 1869 and 1870, Newberry steadfastly defended the need for such basic work before a comprehensive analysis of the economic geology could be completed. Illustrative of Newberry's replies to the criticism befalling him was this statement in the Report of Progress for 1870:<sup>31</sup> "There are, however, yet some intelligent men, even editors and members of the legislature, who cherish the notion that there is nothing which has any value in this world but that thing which has a dollar in it, and that so plainly visible as to be seen by them. Such men, to quote the language of one of them, 'don't care a row of pins for your clams and salamanders, but want something practical.'" Rather unprophetically, and perhaps wistfully, Newberry further states, "Happily the class to which they belong is rapidly passing away."

The Newberry Survey continued as a viable organization until 7 June 1874, although salaries were paid only until

15 February 1874. The total expenditure of the Survey from 1 June 1869 to 1 June 1874 was about \$256,000, of which \$87,000 was for expenses and \$169,000 was for publication costs.<sup>32</sup> Declining financial conditions of the country and the state at the close of 1873 was the principal reason for discontinuing the Survey,<sup>33</sup> but certainly the constant criticism and petty bickering also must have been influential factors.

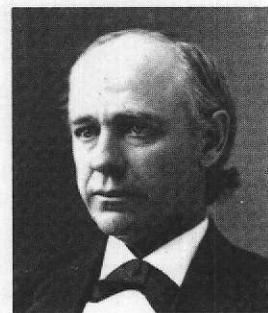
There was no formal organization of the Survey after 1874 and indeed no funding except small amounts to cover some field expenses and printing costs for volumes previously prepared.<sup>34</sup> Only Newberry and Edward Orton, Sr. remained as de facto members of the geological corps. Newberry, without compensation from the state, assembled Volume III, *Geology*, published in 1878, and Volume IV, *Zoology*, published in 1882. Newberry stated in 1882 that these volumes were finished at a cost of several hundred dollars of his own money.<sup>35</sup> With publication of Volume IV, Newberry's tenure as State Geologist of Ohio ended. Work begun under Newberry's direction was continued by Edward Orton Sr., and through the efforts of Orton, Sr. the manuscripts on paleontology prepared originally for a proposed second part of Volume III were finally published in Volume VII.<sup>36</sup>

The geological work done in Ohio under Newberry's direction was the foundation for most later geologic studies, including studies of mineral resources, stratigraphy, and paleontology. Although Newberry's organization was intensely criticized, the work must be considered representative of one of the most significant eras of Ohio geology.

The principal accomplishments of the Newberry Survey were:

- 1) Development of a stratigraphic classification for Ohio from which our modern classification has developed.
- 2) Establishment of the age and correlations of many stratigraphic units.
- 3) First statewide analysis of Ohio geology on a county basis.
- 4) First official geologic map of the state (see Plate 1).
- 5) First comprehensive analysis of Ohio fossils, the studies of which formed, in part, the basis for development of the stratigraphic classification.

Figure 5.4. Edward Orton, Sr., third State Geologist of Ohio, 1882-1899.



- 6) First systematic investigations of the glacial geology of the state.
- 7) Presentation of important aspects of economic geology, particularly coal.

### THE ORTONS' SURVEYS (1882-1906)

In 1882, with publication of Volume IV and the end of Newberry's tenure, his chief assistant, Edward Orton, Sr. (Fig. 5.4), became State Geologist. Orton, Sr. received an appropriation of \$5000 to complete the long-awaited volume on economic geology on which he and others had been laboring for so many years. Volume V was published in 1884 and presented, in more than 1000 pages, detailed descriptions of the coal-bearing strata of Ohio and summaries of the iron, clay, and coke industries in the state. Also included were discourses on the building stones of Ohio and the glacial boundary.

Volume V was apparently received with enthusiasm, and perhaps praise, by the citizens of Ohio, for Orton, Sr. continued as State Geologist. This work was only a part-time position as Orton, Sr. remained Professor of Geology at The Ohio State University. He was unable, however, to include in Volume V the complete information on the coal resources of Ohio, and essentially nothing was included on petroleum and natural gas because of lack of space. The legislature was highly desirous of the report on petroleum and natural gas and therefore appropriated \$4500 to complete this work, which by legislative action on 1 May 1885 was to be in the hands of the printer by 1 October 1885. The frenzied activity in the oil and gas fields of Ohio, particularly the Findlay field (Fig. 5.5), compelled Orton, Sr. to go before the legislature in January 1886 to request an extension on this work so that the abundant new data could be included. The legislature extended Orton's deadline for the manuscript on oil and gas to 1 February 1887.<sup>37</sup> Between January 1886 and February 1887, Orton, Sr. prepared and had printed a slim preliminary report on oil and gas.<sup>38</sup>

Volume VI was published in 1888 and consisted of more than 800 pages of which nearly 600 pages dealt with petroleum and natural gas. Also included in this volume

were chapters on the Pittsburgh coal and the Pomeroy and Federal Creek coal fields, manufacture of salt and bromine, gypsum, lime, and natural and artificial cements, and the glacial drift deposits of the state. The report on petroleum and natural gas by Orton, Sr. is perhaps his finest geological achievement. This work represents a summation of the knowledge known at the time on the origin, accumulation, and production of these fuels; and it is widely quoted even today.

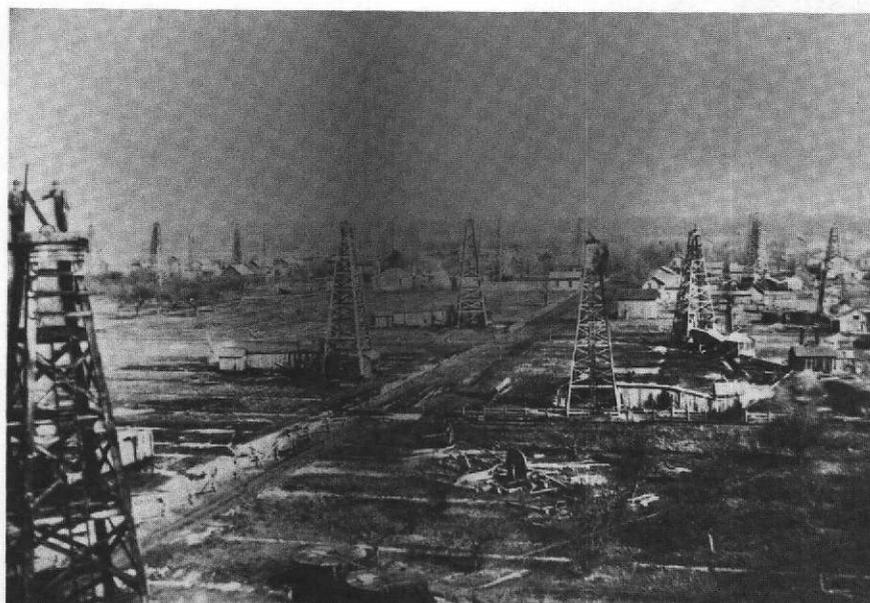
Apparently the long-awaited volumes on economic geology met with favor by the legislature, and a need and benefit were seen in maintaining the Geological Survey on a continuous basis. On 12 April 1889, the legislature established the Third Organization of the Geological Survey with Edward Orton, Sr. remaining as State Geologist. In this legislation was a provision to make the appointment of the State Geologist for a term of three years.<sup>39</sup>

In 1890, the First Annual Report of the Third Organization was published by Orton, Sr. The primary emphasis in this report dealt with the new information on oil and gas with comments on stratigraphic revisions. Orton, Sr. presented his prophetic views on the appalling waste of natural gas in the state and pleaded for curtailment of these practices.

In 1893, Volume VII was published in two parts. Part I, economic geology, contained new and additional information on the stratigraphy, clays, and coals of Ohio; Part II treated botany, archeology, and paleontology. In essence, Part II was a completion of the work promised but never completed by the Newberry Survey. Chapters by R.P. Whitfield and E.O. Ulrich on paleontology were prepared for Volume III, Part II, but never published by the Survey. Additional paleontological work was deemed necessary by Orton, Sr., and reports by C.L. Herrick, A.F. Foerste, E.W. Claypole, and A.A. Wright appeared. Gerard Fowke treated the archeology of Ohio, and W.A. Kellerman and W.C. Werner prepared the botanical report. The botanical report was originally scheduled for Volume IV (1882), prepared by H.C. Beardsley, but the manuscript had been lost.<sup>40</sup>

The publication of Volume VII marked the end of active Geological Survey work under Orton, Sr. and the end

Figure 5.5. Frenzied drilling for oil and gas in northwestern Ohio, beginning about 1885, led to several extensive and seminal reports on oil and gas by third State Geologist Edward Orton, Sr. Cygnet oil field, Wood County, circa 1885.



of an era in Ohio geology. Orton, Sr. continued to hold the position of State Geologist in an honorary capacity, as no appropriations were made and no active investigations were carried out.<sup>41</sup> Edward Orton, Sr. died in October 1899, having been incapacitated by a series of strokes, thus ending 30 years of service to the Ohio Geological Survey. In December 1899, Edward Orton, Jr. (Fig. 5.6) was appointed State Geologist to fill the unexpired term of his father and was reappointed in 1901 and 1904.<sup>42</sup>

In 1900, the Survey was reorganized and became known as the Fourth Organization, which continues to the present. This reorganization was not formalized by legislation but was a change in procedural matters enacted under the direction of Edward Orton, Jr. Prior to the Fourth Organization, the Survey had no office space or equipment; the business of the Survey was conducted in the home or office of Edward Orton, Sr. In 1904, offices at The Ohio State University, stocked with necessary equipment, gave the Survey its first permanent headquarters<sup>43</sup> (Fig. 5.7).

Edward Orton, Jr. appointed Charles S. Prosser and John A. Bownocker as assistant geologists. Numerous other individuals, both students and professors, served with the Survey on a part-time basis. Although important stratigraphic revisions appeared, the focus of the Survey was on economic geology, reflecting the interests of Edward Orton, Jr., who is considered the founder of ceramic engineering. Reports were issued individually

as Bulletins and bound into volumes only when sufficient materials had been published.

### THE BOWNOCKER SURVEY (1906-1928)

Edward Orton, Jr. resigned his position as State Geologist in 1906 and John A. Bownocker (Fig. 5.8) was appointed to take his place. During Bownocker's 22-year tenure, 25 Bulletins were published dealing with diverse topics including mineral resources such as coal, oil and gas, peat, clay, building stones, and ground water; stratigraphy of the Devonian, Mississippian, Pennsylvanian, and Permian Systems in Ohio; paleontology; and important reports on regional geology, including the first detailed county reports. In addition, the present geologic map of Ohio was compiled by Bownocker.

Bownocker was, during this time, Professor of Geology and Chair of the Geology Department at The Ohio State University.

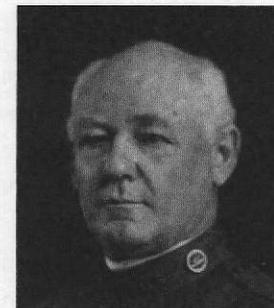
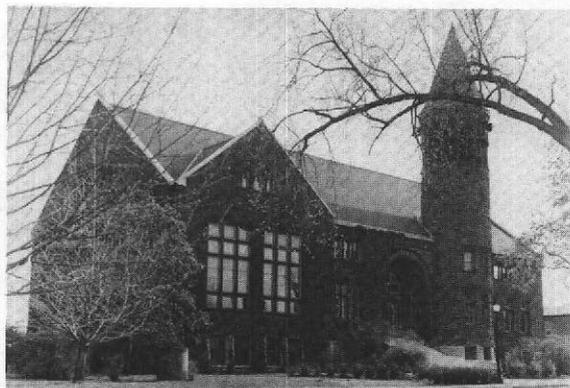
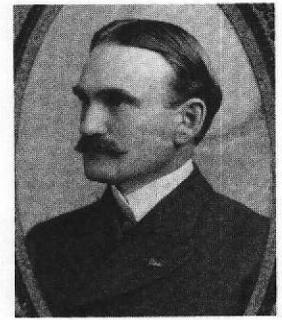


Figure 5.6. Edward Orton, Jr., fourth State Geologist of Ohio, 1899-1906.

Figure 5.7. Orton Hall at The Ohio State University was the home of the Geological Survey from 1904 until 1962. Office space was shared with the University's Department of Geology and Mineralogy. The courses of rock in the building reflect the geological section of Ohio.

Figure 5.8. John A. Bownocker, fifth State Geologist of Ohio, 1906-1928. Photo courtesy of Photo Archives, The Ohio State University.



Numerous students, former students, and professors at Ohio State (Fig. 5.9) were involved to varying degrees in the work of the Survey. Geologists at other institutions in Ohio contributed reports, and Wilber Stout and Raymond E. Lamborn were actively employed by the Survey. The tenure of John A. Bownocker as State Geologist marks an important time in the history of the Survey, as geological investigations on many diverse subjects were published and the Survey was maintained continuously, in contrast to the sporadic investigations during the previous century.

### THE STOUT SURVEY (1928-1946)

With the death of J.A. Bownocker in 1928, Wilber Stout (Fig. 5.10) was appointed State Geologist, becoming the first full-time State Geologist. Unfortunately, Stout's appointment coincided with the economic depression of the 1930's that was to affect financial support and activities for more than a decade.

Soon after Stout took over as State Geologist, the panic of the burgeoning depression reached the legislature, and budgets were cut wherever possible. Among those appropriations to be entirely eliminated for 1932 was that of the Survey. Many people were alarmed by this action, including former State Geologist Edward Orton, Jr. His political influence was great, and he wrote Governor George White imploring him to maintain the Survey even if it meant that only Stout was retained.<sup>44</sup> In addition, the railroads serving Ohio lobbied strongly in the Survey's favor.<sup>45</sup> These pleas were successful in restoring most of the Survey appropriation to the budget.

Stout thanked Orton, Jr. for his efforts and indicated that the State Board of Control provided \$11,555 of the \$15,500 appropriated by the legislature to continue the Survey for 1932.<sup>46</sup> Appropriations for the Survey were,

however, at a subsistence level throughout the 1930's and into the early 1940's. During this period, the Survey staff consisted of Stout and Raymond E. Lamborn (Fig. 5.11) with Ethel S. Dean as Secretary.

During Stout's tenure as State Geologist, Bulletins were published concerning clay, shale, dolomite and limestone, brine, ground water, iron, flint, coal, and marl. Nearly all of these reports were authored by Stout or Lamborn. One of the most widely used publications of the Stout administration was Bulletin 44, *Geology of Water in Ohio*, authored by Stout, Karl Ver Steeg, and George F. Lamb. This 694-page Bulletin, reprinted in 1968 but now again out of print, discussed the surface and ground water resources of each county in Ohio. Had financial conditions in the state been more favorable, the Survey under Stout's direction would undoubtedly have published considerably more reports.

### THE WHITE-MELVIN-BERNHAGEN SURVEYS (1946-1968)

Upon the retirement of Wilber Stout in 1946, George W. White (Fig. 5.12) was appointed State Geologist. White remained in office only a year and a half before accepting the position of Chair of the Department of Geology at the University of Illinois. The Survey remained small during White's brief tenure. However, he made a significant and partly successful plea before the legislature to increase appropriations for the Survey.<sup>47</sup>

John H. Melvin (Fig. 5.13) was appointed State Geolo-



Figure 5.9. In the early part of the 20th Century, the Geological Survey existed on a continuing basis. A variety of studies, such as the investigation of Devonian and Mississippian rocks in northeastern Ohio by Ohio State University Professor Charles S. Prosser in 1910, were published during the tenure of John A. Bownocker as State Geologist. Photo by W.C. Morse, 1909.



Figure 5.10. Wilber E. Stout, sixth State Geologist of Ohio, 1928-1946.

gist in 1947 upon the resignation of White and was successful in increasing Survey appropriations more than twofold in the late 1940's. In 1951, the report of the Ohio Program Commission summarized the Survey's financial situation by concluding that "...the Division of Geological Survey has been one of the most grossly under-supported agencies of the state for many years."<sup>48</sup>

Melvin introduced a new system of presentation of publications which included Reports of Investigations and Information Circulars in addition to Bulletins. This new format allowed brief versions of technical reports and more popular topics to be made available quickly. Melvin also was instrumental in establishing the organizational framework of today's modern geological survey by sectionalizing the functions of the programs. His basic framework has persisted to the present.

In 1949, the Survey became one of the seven originally chartered Divisions in the newly organized Ohio Department of Natural Resources, and the State Geologist became the Division Chief. The Survey offices remained in Orton Hall at The Ohio State University, and mineral resources and regional geology continued to be the primary emphases (Fig. 5.14).

In 1957, Ralph J. Bernhagen (Fig. 5.15) was appointed State Geologist. Investigations on mineral resources and regional geology continued and the technical staff remained at a level between 15 and 20, as it had since 1948.

As a result of the discovery of oil and the resulting oil boom in Morrow County in 1961, the facilities of the Survey at The Ohio State University were inadequate to meet the demands of the petroleum industry as well as the other growing mineral industries in Ohio. Locating new quarters for the Survey became necessary. Although leaving Orton Hall and



Figure 5.11. During the economic depression of the 1930's, the professional staff of the Geological Survey consisted of State Geologist Wilber Stout (left) and his assistant Raymond Lamborn. Although funding was at a subsistence level, Stout and Lamborn prepared and published a number of significant reports on Ohio geology.

the other facilities at The Ohio State University was unpopular with the academic community, moving was imperative if the anticipated growth of the Division were to be achieved effectively. In January 1963, the Survey moved from its cramped quarters at the University to offices at 1207 Grandview Avenue, in the Columbus suburb of Grandview Heights.

### Creation of Lake Erie Section

One of the original seven divisions of ODNR was the Division of Beach (Shore) Erosion. In November 1961, as a result of passage of Amended House Bill 379, this Division was eliminated, and its activities were distributed to other agencies within ODNR. Additional responsibilities were assigned to the Division of Geological Survey as defined in the Ohio Revised Code, Section 1505.6 to 1505.8. The Division acquired five new employees at the Sandusky office along with research facilities, including a 46-foot research vessel, the GS-1 (Fig. 5.16). The Division became responsible for all basic investigations relating to the geology and physical environment of Lake Erie and its shoreline and for the administration of laws pertaining to the exploration and production of minerals below the waters of the lake.

Under the new Section 1505.06, the authority of the Division Chief to use the services of other governmental agencies in cooperative projects was expanded to include shore-erosion projects. Section 1505.07 authorized the Division Chief to issue permits and make leases to parties making application for permission to remove minerals or other sub-

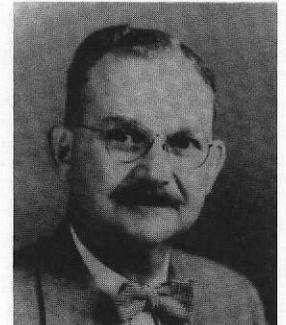


Figure 5.12. George W. White, seventh State Geologist of Ohio, 1946-1947.



Figure 5.13. John H. Melvin, eighth State Geologist of Ohio, 1947-1957

Figure 5.14. In 1949, the Geological Survey became one of the seven originally chartered Divisions of the newly created Ohio Department of Natural Resources. Investigation of mineral resources, as typified by Survey geologists Robert Alberts (left) and Russell Brant examining the Columbus Limestone in Franklin County, reached a new intensity as Survey staff increased dramatically from the subsistence level of the previous two decades. Photo by Art Widdemore, 1960.

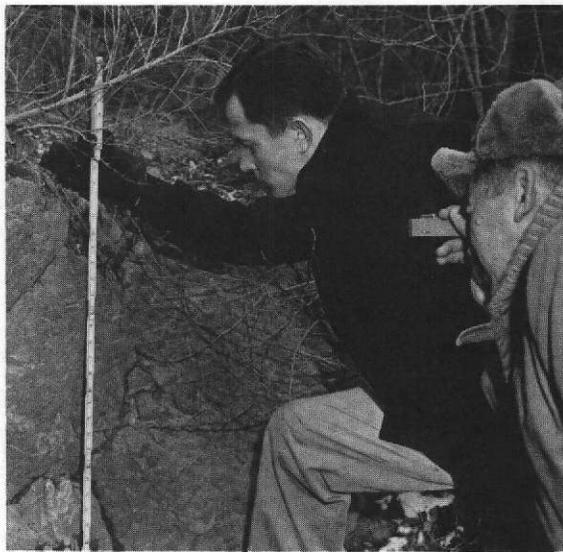


Figure 5.16. In 1961, the Division of Geological Survey assumed responsibilities for study of Lake Erie shore erosion and acquired a 46-foot research vessel, the GS-1, from the former Division of Shore Erosion.



stances from and under the bed of Lake Erie. Royalty or rental money collected from such operations is deposited in a permit-and-lease rotary fund as established by Section 1507.04. The Chief cooperates with the ODNR Chief Engineer in the investigation and preparation of plans for projects to prevent shore erosion.

### Offshore Drilling in Lake Erie

Interest in exploration for oil and gas under the waters of Lake Erie was initiated in 1955 when the former Division of Shore Erosion received an inquiry requesting information on leasing approximately four square miles in Lake Erie off Lakewood in Cuyahoga County. As a result of this interest, the 101st General Assembly by passage of Amended Substitute House Bill 358 amended the Shore Erosion Act to provide for the extraction of oil and gas from under the bed of Lake Erie. Following the enactment of that legislation, ODNR Director Marion authorized preparation of an "operat-



Figure 5.15. Ralph J. Bernhagen, ninth State Geologist of Ohio, 1957-1968. Photo courtesy of John Dobos.

ing procedure for leasing areas and producing oil and gas in Lake Erie." This document was reviewed, revised, and rewritten several times during the period 1955 to 1959.

In the meantime, the Governor of Pennsylvania in 1956 announced that Pennsylvania would allow offshore exploration for new sources of oil and gas. Leases were granted in 1957 on two blocks offshore from Erie, Pennsylvania, and drilling was underway in 1958. Although the two test holes drilled at these blocks did not find commercially productive hydrocarbons, the interest in offshore drilling continued in New York and Ohio.

However, as early as 1957, opposition to offshore drilling was expressed by certain community leaders, conservation groups, and city officials. Their principal concern was the potential pollution that could be caused by oil spills and the resultant deleterious effects on water supply, fish and wildlife, and recreational facilities.

The interest and impetus to pursue Lake Erie drilling was temporarily halted in 1961 with the discovery of petroleum in Morrow County. Following the period of peak activity there in 1963 and 1964, operators who had moved into Ohio revived the interest in Lake Erie drilling. During 1966 and 1967, approximately one-and-a-half million acres in New York, Pennsylvania, and Ohio were under consideration for leasing, and in Ontario all of its offshore acreage of three million acres had been leased or had been requested by application.

In Ohio, 352,000 acres north of Ashtabula County were laid out in leasing blocks ranging from 9000 to 19,000 acres each. Lease forms were prepared, and administrative procedures were established to initiate an active leasing program. Rules and regulations governing drilling in Lake Erie waters were filed in the

1949-1989

office of Secretary of State on 2 January 1968. A public hearing on these rules and regulations was conducted on 5 February 1968. Testimony at the hearing in opposition to the program and subsequent correspondence to ODNR Director Morr and Governor James A. Rhodes were so overwhelmingly negative that the entire program was canceled. Before adjourning in 1968, the 107th General Assembly passed legislation banning drilling in Lake Erie for a two-year period. The 108th and 109th General Assemblies enacted similar legislation, and the 110th General Assembly banned drilling until July 1978.

### Topographic Mapping Program

Topographic mapping is by no means new to Ohio. In 1902, the state started with a \$50,000 program; at that time there were similar programs in only nine other states. The early mapping spanned a period of about 16 years, resulting in complete coverage of the state with more than 200 separate 15-minute (1:62,500) scale quadrangle maps. This mapping had served the state for many years. However, on the basis of modern standards, it was no longer adequate to meet the demands of industry, transportation, communication, and agricultural and recreational development. A large-scale, more detailed, and more accurate coverage was required.

Shortly after his appointment as the eighth State Geologist, John H. Melvin initiated a campaign to have Ohio remapped topographically on the new 7.5-minute (1:24,000) scale. Constant persuasion directed through the Ohio Chamber of Commerce, professional geologist and engineering groups, and numerous conservation societies eventually was effective but only after Melvin had completed his term of office as State Geologist. Ohio reportedly was the first state in the Union to have been completely mapped on the old 1:62,500 scale during the early decades of the 1900's, and Ohio would be the first state to be completed on the new modern scale.

In 1957, the 102nd General Assembly appropriated \$100,000 to initiate a statewide topographic mapping program in cooperation with the United States Geological Survey (USGS). This amount was matched with federal

funds, and the total money was expended by the spring of 1959. Because of the importance of modern topographic maps to the highway program, Everett Preston, Director of the Ohio Department of Highways, offered to support the program with additional funds from his department. Approximately \$150,000, matched by an equal amount of federal money, was put into the program, resulting in a total of approximately \$500,000 available during the biennium.

In November 1958, ODNR Director Eagon, Ohio Department of Highways Director Preston, and Division Chief Bernhagen flew to Washington D.C. to negotiate the terms of the agreement with USGS. Within the next six years the state was mapped at the 1:24,000 scale at a cost of \$6.5 million—the largest cooperative mapping program ever undertaken by USGS (Fig. 5.17). Ohio is now covered by 788 7.5-minute quadrangle maps on the scale of one inch represents 2000 feet.<sup>49</sup>

In addition to the conventional information displayed on topographic maps, these maps also contain data of the Ohio Coordinate System. This system consists of a network of plane rectangular coordinates which has been computed by the National Geodetic Survey. A separate system for each state is derived mathematically from geodetic data which constitute the national triangulation network. The purpose of the coordinate systems is to make the geodetic data of the national survey available on a plane projection for use by surveyors and other mapping agencies. In anticipation of the proposed new topographic mapping program for Ohio, Chief Melvin, in cooperation with professional engineer and surveyor organizations, prompted the General Assembly in 1956 to enact Senate Bill 299. This legislation set the precedent for the incorporation of the Ohio Coordinate System in the USGS mapping program. As a result, the network of plane rectangular coordinates is recorded on each of the 788 7.5-minute topographic maps covering Ohio.

### Development of the Salt Industry

In the late 1950's, considerable interest was expressed in the exploration for rock salt in the northeast quadrant of Ohio, particularly adjacent to and beneath the water of Lake

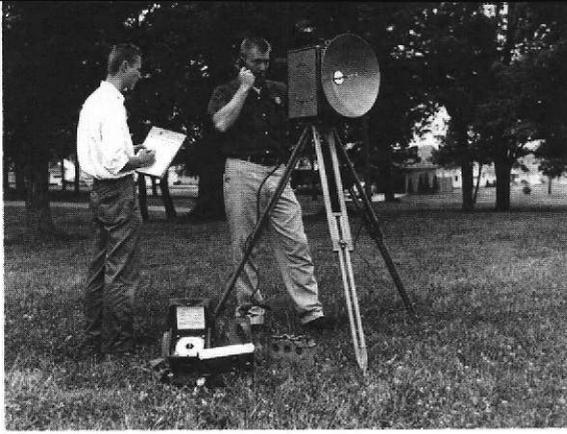


Figure 5.17. In 1959, Ohio began a cooperative program with the United States Geological Survey to prepare 7.5-minute topographic quadrangle maps for the entire state. USGS engineers are here working with the tellurometer, a radio wave sounding device used in making ground surveys preparatory to development of topographical maps. Within six years, 788 maps were finished and Ohio became the first state to have complete detailed map coverage.

Erie. Extensive test drilling programs conducted by the International Salt Company and Morton Salt Company resulted in the selection of two sites favorable for the development of two deep mines.

Following negotiations between officials of the two salt companies and representatives of the Natural Resources Commission, approval was granted for the location of the International Salt Company mine at Whiskey Island near the mouth of the Cuyahoga River in Cleveland and the Morton Salt Company mine at Fairport Harbor in Lake County. The State of Ohio was represented by ODNR Director Eagon; Dr. Myron T. Sturgeon, Chair of the Natural Resources Commission; F.O. "Barney" Kugel, Chief of the Division of Shore Erosion; his Assistant Chief, John Hyland; Division Chief Bernhagen; and other state officials. The International Salt Company contract was finalized on 11 July 1957, and the Morton Salt Company contract was dated 12 November 1958.

During the negotiations, both Bernhagen and Hyland persisted in the principle that royalty payments for all mineral extractions should be on the basis of a percentage of the market price of the commodity. Unfortunately for the Department, when the contracts were submitted to the State House for approval, the royalty was set at *five cents per ton* rather than *five percent of the current market value*. At that time, the market price of salt was about \$6.00 per ton; the price of salt now is approximately \$10.00 per ton. Nevertheless, between 1957 and 1986, over 55.3 million tons of salt have been mined by the two companies with total royalty payments amounting to over \$3.7 million. During the same period, sand and gravel production from Lake Erie was more than 1.8 million cubic yards, resulting in royalty revenue of more than \$5.5 million.

### The Ohio-Michigan Boundary Dispute of the 1960's

The rivalry between the States of Ohio and Michigan was manifest in the boundary disputes that prevailed in both the 19th and 20th Centuries. In both cases—the so-

called "Toledo War of 1836" and the "Western Lake Erie Dispute of 1966"—Ohio came out of the melee victorious. In April 1966, the Michigan legislature instructed its Attorney General to apply to the United States Supreme Court for a decision on the boundary dispute involving about 200 square miles in Lake Erie. Michigan claimed that the boundary in the lake should continue eastward until it meets the international boundary between the United States and Canada; Ohio claimed that the boundary should extend northeasterly through the Turtle Island boundary monument to the intersection with the international boundary (Fig. 5.18).

In compliance with the Michigan request, the Supreme Court assigned as referee Federal Judge Albert B. Maris of Philadelphia, Pennsylvania. The first of a series of hearings was held on 18 October 1967, in the Toledo Federal Building. The State of Ohio was represented by the office of Ohio Attorney General William B. Saxbe and several delegates from ODNR including Division Chief Bernhagen and representatives of the Divisions/Offices of Water, Wildlife, Engineering, and Watercraft.

Late in 1973, Judge Maris agreed with Ohio's claim, noting that the 1836 law fixed the boundary at an angle of 45 degrees from the most northerly cape of Maumee Bay. He observed that the cape marked in 1817 had washed away, but he agreed with Ohio's contention that the line traverses the existing circular concrete seawall on Turtle Island. The Supreme Court heard arguments in December 1973 on Judge Maris' findings. Its decision was unanimous—a brief unsigned opinion adopting Judge Maris' conclusions.

### Morrow County Oil Boom

The early 1960's witnessed one of the most active periods in the history of the Survey. Requests for information on Ohio mineral resources came from such places as Great Britain, Idaho, Pennsylvania, Kansas, Michigan, and of course, Ohio. With the intensive action associated with the Morrow County oil boom, the Subsurface Section was particularly affected. This group underwent considerable

1949-1989

changes in 1965. A new section head was appointed in October and a portion of the activities of the former Industrial Minerals Section was transferred to the new section in January. The new section, now called the Subsurface and Economic Geology Section, was administrated by Donald Norling, whose predecessor, Warren Calvert, had resigned to return to the oil and gas industry.

The discovery of oil in Morrow County stimulated new thinking in governmental circles relative to the management of the petroleum industry in Ohio. Historically, the laws of the petroleum industry were administered by the Division of Mines in the Ohio Department of Industrial Relations, whose principal interest was the protection of the coal mines of eastern Ohio. As oil well drilling escalated in Morrow County, the inadequacies of existing laws became apparent. The Division of Geological Survey played an active part in the preparation of new rules and regulations which became effective 20 March 1964. This was accomplished through close cooperation with the Ohio Oil and Gas Association, the Legislative Service Commission, and the Oil and Gas Committee created by the 105th General Assembly in the study and preparation of future legislation. Survey staff members Warren Calvert, Don Norling, Ted DeBrosse, and Chief Bernhagen spent many hours working with industry representatives and John McElroy, Governor Rhodes' chief legislative advisor. The ultimate resolution of the efforts of many persons and organizations was the passage of House Bill 234 by the 106th General Assembly, which created the Division of Oil and Gas effective 15 October 1965<sup>50</sup> (see Chapter 15).

### THE COLLINS SURVEY (1968-1988)

In 1968, Horace R. Collins (Fig. 5.19) was appointed the tenth State Geologist of Ohio. At that time, the Division staff consisted of 19 full-time employees, nine of whom were geologists or other scientific staff. The annual budget for fiscal year 1968 was \$337,000.

Increasing emphasis on environmental concerns in the early 1970's by ODNR and society in general prompted an expansion of Survey staff to meet the demands of the

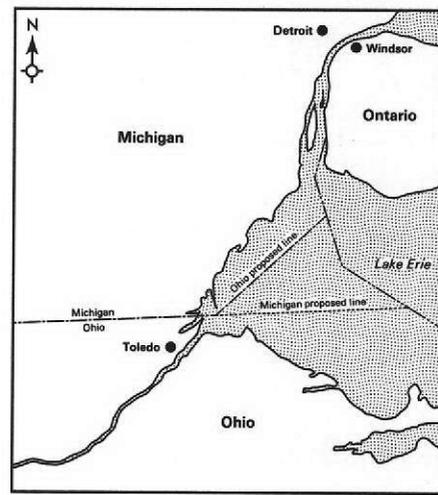


Figure 5.18. The Ohio-Michigan boundary dispute in the 1960's was resolved by the United States Supreme Court in 1973 when it determined that the line proposed by Ohio was the legitimate boundary.

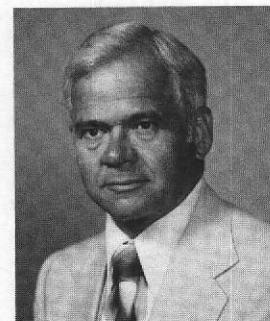
Department's programs in this area. A geochemistry program, begun in 1969 with the acquisition of an atomic absorption spectrometer, resulted in the establishment of a well-equipped geochemistry laboratory in the early 1970's. Analytical capabilities of the Survey at this time were increased also by the addition of an X-ray diffraction unit for mineral identification and by the addition of a sedimentology laboratory.

In conjunction with a consolidation effort by the Department, the Division moved its offices to the Fountain Square Complex in 1973. The Lake Erie Section of the Survey remained in offices at the Division of Wildlife facility in Sandusky. The Division also utilized several buildings at the 1500 Dublin Road (Columbus) facility of the Department for core and sample storage and for "dirty" laboratories in which rock crushing, grinding, and cutting procedures were performed.

In the early to mid-1970's, the Division was heavily involved in a program concentrated in northeastern Ohio to prepare top-of-rock, drift-thickness, waste-disposal, geologic materials, and other derivative maps. Glacial geology maps and reconnaissance-scale bedrock geology maps also were prepared. Data from this effort were extensively used by the Department's Ohio Capability Analysis Program. In 1973 and 1974, the Water Inventory Section of the Division of Water was transferred to the Division of Geological Survey as part of a departmental reorganization. In 1975, this section was reunited with the Division of Water.

Throughout the 1970's, the Survey emphasized mineral-resource studies, which included coal, sand and gravel, oil and gas, limestone, sandstone, clay, and salt. Budgetary restrictions, particularly in the late 1970's, limited county mapping of bedrock, although mapping of glacial geology in northeastern Ohio progressed through the contract work of former State Geologist George W. White and Stanley M. Totten. Studies of erosion along the Lake Erie shore continued also.

Figure 5.19. *Horace R. Collins, tenth State Geologist of Ohio, 1968-1988.*



In the mid-1970's, during a time of reduced availability of imported oil, the Subsurface Geology Section developed Ohio's self-help drilling program. This program encouraged businesses and manufacturers to obtain their natural gas supplies from wells drilled on their properties.

In 1976, the Subsurface Geology Section began an extensive investigation of the Ohio Shale as part of the United States Department of Energy's Eastern Gas Shales Project. Although this project was completed in 1982, it spurred great interest in the black shales of Devonian age. The Division has recently completed a major project, funded by the Gas Research Institute of Chicago, to create a computerized database of producing gas wells in the Ohio Shale and to analyze production trends from this database.

The period from 1979 through 1983 marked a drilling boom in Ohio's oil and gas fields and much of the effort of the Subsurface Geology Section at this time was directed towards the processing and filing of well logs and other data and supplying this information to industrial customers. In the mid-1980's, the Subsurface Geology Section's physical facilities were upgraded, including providing study space for the public and a walk-in file system for geophysical logs.

Following the passage of House Bill 385 in late 1981 by the 114th Ohio General Assembly, the Division of Geological Survey was able to begin a full-scale county geologic mapping program. This legislation, which included a ten-year sunset clause, diverted approximately eleven percent of the total of the mineral severance tax to the Survey for the purpose of funding the mapping program. The goal of the mapping program was to prepare for each county in the state bedrock, glacial (where appropriate), and various other maps.

Although there was a time lag in getting necessary mapping personnel on staff, brought about by statewide employee ceilings and by the necessity for sufficient severance-tax monies to accumulate before hiring could commence, most of the authorized mapping personnel were on staff by 1984. These geologists were part of the Regional Geology Section and were subdivided into groups representing bedrock mapping, glacial mapping, and top-of-rock/drift-thickness mapping. Two geologists were added to the Subsurface Geology Section and additional cartogra-

phers supplemented the map-preparation capabilities of the Technical Publications Section.

Bedrock mapping began on two fronts. Mapping of Lower Paleozoic rocks began in southwestern Ohio in Hamilton and Clermont Counties and advanced into adjacent counties. Mapping in this portion of the state was a significant change from previous mapping efforts, which concentrated primarily on the coal-bearing counties of eastern Ohio. Mapping of Upper Paleozoic rocks began in northeastern Ohio in Columbiana, Mahoning, and Jefferson Counties.

Glacial mapping began in north-central Ohio as a continuation from northeastern Ohio counties mapped by George W. White and Stanley M. Totten in the 1970's and earlier. The plan was to move westward and southward across the glaciated portion of Ohio. Because of ongoing funding, mapping of glacial as well as bedrock units was able, for the first time, to proceed on a systematic fashion. This procedure takes genetic origin of the mapped units into account rather than "hopping" from area to area.

The Survey acquired a core-drilling rig in 1981 as part of a program to characterize the state's resource base of coal and industrial minerals and to provide stratigraphic data for county bedrock mapping. This rig, a Mobile B-61 (Fig. 5.20), has a coring capacity of nearly 3000 feet, which was tested in 1985 in a 2900-foot hole drilled in Seneca County in northern Ohio. In 1986, the Survey purchased a Longyear Hydro-44 coring rig, with a capability of nearly 6000 feet, and a CME auger rig for use in glacial mapping studies. These rigs, plus the staff of the Division, were given a severe test in early 1987 when the Survey was assigned the task of developing detailed site geology for a Superconducting Super Collider site in central Ohio. Twenty-two bedrock holes and 16 glacial drift holes were drilled in approximately two months. In addition, 28 staff members were involved in mapping the multi-county area and analyzing data critical to locating a site in Ohio. This monumental task produced substantial information and was completed on schedule in less than four months. A subsequent federal decision, however, located the facility in Texas.

In April 1989, the Division completed a continuous core hole to a depth of 5380 feet in Warren County (see

Figure 1.12 on page 6). This is the deepest continuous core in Ohio, and possibly in the eastern United States.

As a result of House Bill 385 in 1982, the Division of Geological Survey took over the mineral-statistics program from the Division of Mines in the Ohio Department of Industrial Relations. The 1981 and 1982 *Report on Ohio Mineral Industries* were published by the Survey using data acquired by the Division of Mines. In 1983, the Survey first published this annual report using data acquired solely by the Survey.

In the early 1980's, a program for the study of pyrite in Ohio coal was begun. To carry out this work, the Division substantially upgraded its coal petrography equipment and facilities including acquisition of a Leitz computerized image-analysis system (Fig. 5.21). This program, funded in part by a grant from the Ohio Air Quality Development Authority, examined the washing characteristics of Ohio coal and compared washing results with petrographic analyses. Based on this work, theoretical maximum cleaning potential for grain sizes of coal were developed.

Among additional activities of the Division in the mid-1980's were the acquisition of a major core and sample library facility, publication of an aeromagnetic map of Ohio in cooperation with USGS, and the acquisition of sidelooking airborne radar imagery for the Cleveland, Canton, Clarksburg, Charleston, Marion, and Muncie quadrangles, also in cooperation with USGS.

In 1987, the Ohio Geological Survey celebrated the 150th anniversary of its founding in 1837. The Sesquicentennial celebration was highlighted by a banquet and open house on 27 March 1987, the anniversary of the day that legislation was passed authorizing the Survey. The banquet was attended by nearly 300 people and featured a keynote address by Dallas L. Peck, Director of the United States Geological Survey, and remarks by ODNR Director Sommer. Chief Collins served as master of ceremonies.

A special feature of the banquet was the presentation of the W.W. Mather Medal to Dr. Myron T. Sturgeon, Professor Emeritus of



Figure 5.20. In 1981, the Division of Geological Survey acquired its first core-drilling rig. This equipment gave the Division the capability to expand its detailed investigations of the state's geology into a new frontier—the subsurface. Photo by Michael C. Hansen, 1987.

Geology at Ohio University and former longtime member and Chair of the Natural Resources Commission. The award, named after Ohio's first State Geologist, recognizes significant, lifelong contributions to Ohio geology.

Additional Sesquicentennial activities included hosting the annual Midwest Friends of the Pleistocene meeting, a special display at the Eastern Section meeting of the American Association of Petroleum Geologists, and a fossil-collecting field trip to Caesar Creek State Park in Warren County.

In response to a Survey proposal to the National Science Foundation in 1983, the Consortium for Deep Continental Reflection Profiling (COCORP) began a continuous seismic line across Ohio from the Indiana-Ohio border to the Ohio River in eastern Ohio in late 1987. The objective of this study was to examine deep crustal structures in the state including the Grenville Front, a boundary between two provinces of Precambrian rocks. The results of the COCORP profile, released in 1989, created considerable interest among geologists and received widespread publicity across the state. Not only was the Grenville Front identified in west-central Ohio, but a previously unknown disturbed zone was discovered in eastern Ohio. This zone of disturbed rocks is thought to mark the site of the collision of two continents about a billion years ago.

In 1988, the staff of the Division had increased to 68, which included 34 scientific personnel. The Survey budget for fiscal year 1987-88 was \$2.86 million. Chief Horace R. Collins retired on 30 April 1988.

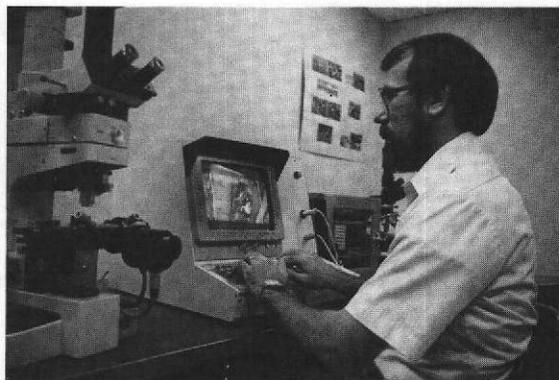


Figure 5.21. The 1970's and 1980's were marked by expansion of the Division of Geological Survey's capabilities into analytical studies by addition of a geochemistry laboratory and computerized microscope equipment. Survey Geologist Richard W. Carlton has investigated the distribution of pyrite in coal using this computerized image-analysis system.

Figure 5.22. Thomas M. Berg, eleventh State Geologist of Ohio, 1989 to the present.



## THE BERG SURVEY (1989-PRESENT)

In March 1989, Thomas M. Berg (Fig. 5.22) was appointed the eleventh State Geologist and Chief of the Division. He came to the Division from the Pennsylvania Geological Survey, where he had been for nearly 25 years,

serving as Associate State Geologist and Chief of the Mapping Division. One of Berg's first scientific priorities for the Division of Geological Survey was to initiate a project to produce a new geologic map of Ohio to replace the 1920 version still in use.

## REFERENCES

- Smyth, Pauline. 1979. *Bibliography of Ohio geology 1755-1974*. Ohio Geological Survey Information Circular 48. 249 pp.
- Merrill, G.P. 1920. *Contribution to a history of American state geological surveys*. United States National Museum Bulletin 109. 549 pp. (Ohio, pp. 387-427).
- Hansen, Michael C. and Horace R. Collins. 1979. A brief history of the Ohio Geological Survey. *Ohio Journal of Science* 79(1):3-14.
- Mather, W.W. 1838. Second annual report. *Geological Survey of Ohio*. pp. 5-39. (esp. p.6).
- See No. 2, pp. 387-388.
- Stoddard, P.W. 1928. Story of the first Geological Survey of Ohio, 1835-1842. *Ohio Archaeological and Historical Society Publication* 37:107-135. (esp. p. 108).
- Hildreth, S.P. 1836. Report of the committee of a geological survey of the state. Ohio General Assembly Legislative Report No. 1:65-78. (esp. p. 65).
- See No. 7.
- Riddell, J.L. and I.A. Lapham. 1837. Report of John L. Riddell, M.D. Ohio General Assembly Report No. 60. 34 pp.
- See No. 6, p. 116.
- See No. 2, p. 394.
- See No. 7, p. 77.
- Orton, Edward, Sr. 1894. Geological surveys of Ohio. *Journal of Geology* 2:502-516. (esp. p. 504).
- See No. 6, pp. 121-125.
- Waller, A.E. 1943. Dr. Samuel P. Hildreth. 1783-1863. *Ohio State Archaeological and Historical Society Quarterly* 53:313-338. (esp. p. 336).
- See No. 13, p. 507.
- See No. 6, pp. 128-129.
- See No. 2 p. 395.
- See No. 6, pp. 121-125.
- See No. 2, p. 423.
- Mather, W.W. 1838. First annual report. Geological Survey of Ohio. pp. 5-23.
- See No. 4.
- Smith, T.H. 1977. *The Mapping of Ohio*. Kent State University Press, Kent. 252 pp.
- See No. 21, p. 21.
- See No. 2, p. 400.
- Locke, John. 1838. Geological report on southwestern Ohio. Second annual report. Geological Survey of Ohio. pp. 201-274.
- Newberry, John S. 1871. Report on the progress of the Geological Survey of Ohio in 1869. Ohio Geological Survey Report of Progress, 1869. pp. 3-51. (esp. p. 6).
- See No. 27, p.7.
- See No. 2, p. 403.
- Ohio General Assembly. 1870. Report of the House Committee on Retrenchment...to inquire into and investigate the expenditures of the Geological Survey of the State. 28 pp.
- Newberry, John S. 1871. Report of progress of the Geological Survey in 1870. Ohio Geological Survey Report of Progress, 1870. pp. 5-53. (esp. p.8).
- Newberry, John S. 1874. Preface. Ohio Geological Survey, Volume II, Part I: Geology, p. ix-xv. (esp. p. xiv).
- See No. 13, p. 511.
- See No. 2, pp. 423-426.
- Newberry, John S. 1882. Preface. Ohio Geological Survey, Volume IV, Zoology, pp. v-viii.
- Orton, Edward, Sr. 1893. Preface. Ohio Geological Survey, Volume VII, Economic Geology, pp. v-xvi.
- Orton, Edward, Sr. 1888. Preface. Ohio Geological Survey, Volume VI, Economic Geology, pp. v-viii. (esp. p. vi).
- Orton, Edward, Sr. 1886. Preliminary report upon petroleum and inflammable gas. Ohio Geological Survey. 76 pp.
- Orton, Edward, Jr. 1906. Preface. Ohio Geological Survey, Volume VIII, pp. v-xxv. (esp. p. v).
- See No. 36, p. vii.
- See No. 39, p. 5.
- See No. 41.
- Orton, Edward, Jr. 1906. Preface. Ohio Geological Survey, Volume IX, pp. v-xxiv. (esp. p. xxii).
- Orton, Edward, Jr. 1931. Letter to Governor White, 21 July 1931. The Ohio State University Archives.
- Stout, Wilber. 1931. Personal communication to Myron T. Sturgeon.
- Stout, Wilber. 1931. Letter to Edward Orton, Jr., 15 October 1931. The Ohio State University Archives.
- Anonymous. 1947. Newspaper article. *Columbus Citizen*, 15 June 1947.
- Ohio Program Commission. 1951. Biennial report to the Governor and the 99th General Assembly. p. 50.
- Anonymous. 1957-1961. Annual reports. Ohio Department of Natural Resources. 1957-1958, p. 88; 1958-1959, p. 10; 1960-1961, p. 10.
- Anonymous. 1964-1965. Annual reports. Ohio Department of Natural Resources.