

CROSSROADS OF ART, EDUCATION, AND GEOLOGY IN NEW HARMONY, INDIANA: A NEW EXHIBIT AT THE WORKING MEN'S INSTITUTE

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ABSTRACT. The Working Men's Institute (WMI) in New Harmony is the oldest continuously operating public library in Indiana. WMI was established in 1838 by William Maclure, "Father of American Geology", to establish a common place for people to further their knowledge and education. The concept of a combined library and museum evolved from Maclure's emphasis on education, and in particular, the Pestalozzian method. A new exhibit at the WMI entitled "New Harmony: Crossroads of Geology" was completed in August 2014. The exhibit displays a reproduction of the 1818 geologic map of the eastern United States compiled by William Maclure. Panels in the exhibit also highlight the evolution of the geologic time scale, localities near New Harmony significant to early scientific studies, and contributions of David Dale Owen, Richard Owen, and Edward Cox to westward expansion of the United States in the early 19th century. Moreover, panels in the exhibit highlight modern studies in southern Indiana, such as seismic monitoring of the Wabash Valley Fault Zone and flooding hazards of the Wabash River. In addition to the exhibit, fossil and mineral kits for use by K–12 teachers are available from the WMI. Activities planned with the kits include: sketching, building models, conducting hands-on experiments, and identifying fossil and mineral specimens. These applied approaches are aligned with teaching methods championed by Maclure. Furthermore, the new exhibit follows the educational tradition of the WMI established by Maclure in 1838.

Keywords: education, geology, New Harmony, sketching, William Maclure, Indiana

INTRODUCTION

The historic town of New Harmony, located along the Wabash River in Posey County, Indiana, was an early 19th century hub for natural scientists, especially geologists (Fig. 1). Notable geologists that lived in New Harmony in the 19th century included: William Maclure, David Dale Owen, Richard Owen, Gerard Troost, Edward Cox, Joseph Norwood, and James Sampson (Pitzer 1989, 1998; Straw & Doss 2008). Other naturalists that worked in New Harmony included Charles Alexandre Lesueur and Thomas Say, and the town was also visited by Charles Lyell, James Hall, and Maximilian, Prince of Wied (Thomas & Hannibal 2008).

The Working Men's Institute (WMI) in New Harmony was established in 1838 by William Maclure, "Father of American Geology", as a place for citizens to further their knowledge and education (Williams 1950; Douglas 1991; Lowe & Stone 2003; Warren 2009). WMI pioneered the combination of library with museum, a concept

that evolved from Maclure's emphasis on education, and in particular, the Pestalozzian method. Today WMI is the oldest continuously operating public library in Indiana (Lowe & Stone 2003).

The scientific accomplishments of William Maclure, David Dale Owen, and other early geologists were highlighted in a comprehensive exhibit in the Keppler House of Historic New Harmony until 2007. At this time, the Keppler House was renovated and the geology displays were dismantled and placed into storage. In preparation for the New Harmony Bicentennial in August 2014, a new exhibit was planned and completed at the WMI from September 2012 to July 2014. The new exhibit highlights the geologic contributions of William Maclure, David Dale Owen, Richard Owen, and Edward Travers Cox, and includes items from the Keppler House, fossil and mineral specimens from WMI, and other items from the geology collections at the University of Southern Indiana. In addition to the new exhibit, fossil and mineral kits were assembled to provide hands-on activities at WMI and to serve the needs of teachers in the Tri-State region (Indiana, Illinois, and Kentucky). Moreover, instructional guides were prepared to outline

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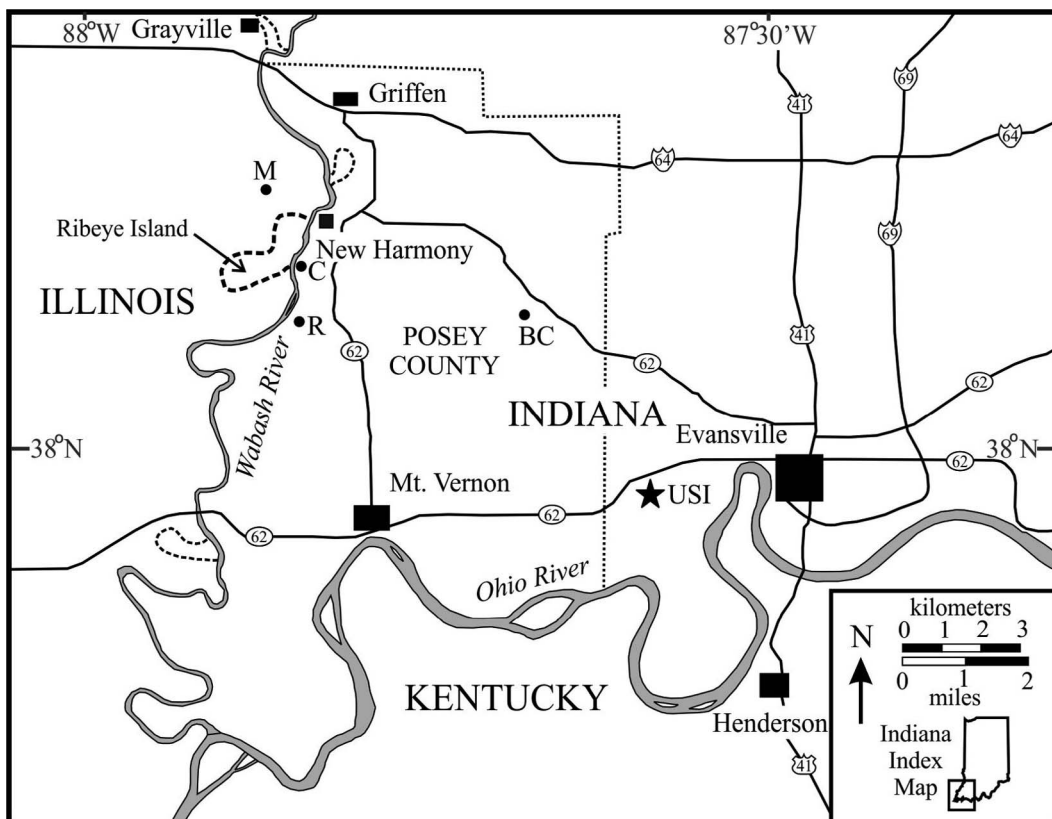


Figure 1.—Map showing the location of New Harmony and several historic geologic localities: BC – Big Creek, C – Wabash Cutoff, M – Mumford Hills, R – Rush Creek, and USI – University of Southern Indiana.

lesson plans for engaged learning activities. These activities include, but are not limited to: (1) maintaining a science notebook; (2) sketching fossils and minerals; (3) recording field observations; and (4) using field guides to identify fossil and mineral specimens.

The objectives of this paper are to: (1) summarize the unique characteristics of the educational enterprise in relation to the natural sciences in the early 19th century of New Harmony, Indiana; (2) highlight the components of a new geology exhibit and related outreach activities at the WMI in New Harmony, Indiana; and (3) focus on the contemporary implications of engaged learning and the integration of arts with natural sciences in achieving modern educational goals.

ART, EDUCATION, AND GEOLOGY IN 19TH CENTURY NEW HARMONY

Robert Owen (1771–1858) was born in Newton, Wales, and married Caroline Dale in 1799 in

Scotland, the daughter of the New Lanark cotton mill’s proprietor David Dale (1739–1806). Robert Owen’s success with mill operations made him a rich industrialist by the early 19th century. In his industrial pursuits, Robert Owen evolved into a social reformer interested in developing a balanced and educated society. To expand his ideas on social reform, Robert Owen purchased the town of New Harmony, Indiana from the Harmonists in 1824 to establish a Utopian society of artists, scientists, and social reformers (Carmony & Elliott 1980).

William Maclure (1763–1840) is known as the “Father of American Geology”. Notably, he completed the first geologic map of the eastern United States in 1809, published in the *Transactions of the American Philosophical Society* (Maclure 1809; Merrill 1924, p. 31–32; Winchester 2013, p. 82). In 1812, Maclure was a founding member of the Academy of Natural Sciences of Philadelphia, and later became president in 1817. He also presented a revised geologic map of the

eastern United States to the American Philosophical Society in 1817, with printed and hand-colored copies distributed with the *Transactions of the American Philosophical Society* in 1818 (Maclure 1818; Merrill 1924, p. 34).

Maclure became intrigued with the Pestalozzian teaching method in 1805 while living in Switzerland. Specifically, the Pestalozzian method focuses on learning through hands-on, concrete experiences such as sketching and individualized curricula (Pitzer 1998). Maclure realized the importance of this new approach and established a Pestalozzian school in Philadelphia led by Joseph Neef (1770–1854) in 1809. Through his professional activities Maclure established friendships with many of the prominent scientists and educators of his time, such as Charles Alexandre Lesueur and Thomas Say. Thus, it was no surprise that Robert Owen collaborated with William Maclure to conduct an experiment in social and educational reform in New Harmony, Indiana (Burgess 1998; Pitzer 1998; Warren 2009; Winchester 2013, p. 85).

The partnership between Robert Owen and William Maclure resulted in artists, educational reformers, and natural scientists joining the New Harmony social experiment. Many started their journey to New Harmony in Pittsburgh, Pennsylvania on Thursday, December 8, 1825 (Pitzer 1998). The passengers and crew departed on a keel boat named “Philanthropist”, often referred to as the “Boatload of Knowledge”. They arrived safely in Mount Vernon, Indiana on January 23, 1826 (Fig. 1) and the following day were transported by wagons to New Harmony (Pitzer 1998).

The passengers on the *Philanthropist* included Thomas Say (1789–1834), an American naturalist, entomologist, and conchologist, and Charles Alexandre Lesueur (1778–1846), a French naturalist, zoologist, ichthyologist, artist, and teacher (Pitzer 1998). Additionally, prominent educators of the time made the journey on the *Philanthropist*. Madame Marie Louise Duclos Fretageot (1783–1833), French educator who established a Pestalozzian school in Philadelphia (1821–1825), joined the social movement in New Harmony. Likewise, William S. Phiquepal d’Arusmont, a French educator, became engaged with the School of Industry in New Harmony shortly after their arrival in 1826. Pestalozzian teacher Joseph Neef, although not on the *Philanthropist*, joined the New Harmony community March 20, 1826 after encouragement by Maclure (Pitzer 1998).

In 1827, Maclure arranged for a printing press to be delivered to New Harmony from New Orleans to aid in production of educational materials (MacPhail & Sutton 1998). Maclure realized the importance of printing books and, most significantly, reproducing sketches and drawings. The following passage from an essay entitled “Education” first printed on 13 February 1828 in the *The Disseminator of Useful Knowledge* highlights Maclure’s emphasis on the importance of art to learning: “The art of drawing or delineation, which has been placed (because its utility was not well understood) amongst the fine arts, must be ranked amongst those which are useful, as it is probably the most expeditious, correct, easy and pleasant mode, of giving ideas both to children and adults” (*The Disseminator of Useful Knowledge* 13 February 1828 in Maclure 1831, p. 48).

Maclure also recognized the importance of sketching to natural history and visualizing concepts that would simply be too difficult to convey through words: “Representation is the only defined language, and is perhaps equal in value and utility to all the languages together; without it, we can have no correct idea of mechanics or natural history; when the objects themselves are absent, descriptions, from the undefined nature of words, must be equally vague and uncertain” (*The Disseminator of Useful Knowledge* 13 February 1828 in Maclure 1831, p. 48–49).

The following passage is from an essay entitled “Industrial System of Education – Obstacles to Reform in Education” first printed on 26 April 1828 in the *The Disseminator of Useful Knowledge*: “The drawing from the object itself therefore probably is the most useful mode [of learning]. Substituting a long tedious process of copying, in place of a short expeditious mode by the copperplate press, would be losing the benefit of that admirable invention” (*The Disseminator of Useful Knowledge* 26 April 1828 in Maclure 1831, p. 67). In this passage, Maclure suggests that sketching from an original object is much more conducive to learning than observing images produced by copper plate etching, wood block engraving, or lithography.

As part of the social experiment, Maclure recruited scientists with artistic skills to live in New Harmony to teach their approach to scientific observation and documentation, as well as conduct studies of the natural environment. These included Charles Alexandre Lesueur

(1778–1846), who lived in New Harmony from 1825 to 1837, where he filled sketchbooks of drawings of flora and fauna. Likewise, Thomas Say (1787–1834) studied shells and insects, leading to the publication (1830–1834) of *American Conchology* in three volumes. The sketches of shells in Say's *Conchology* volumes were printed and hand colored in New Harmony at the School Press (Banta 1948; Pitzer 1998; Thomas & Hannibal 2008). Ultimately, the significance of art to documenting scientific observations was most likely taught to David Dale Owen (1807–1860) and Richard Owen (1810–1890) by Lesueur and Say.

David Dale Owen, son of Robert Owen, became one of the most prominent American geologists in early 19th century (Hendrickson 1940; Johnson 1977; Thomas & Hannibal 2008). Although David Dale Owen and William Maclure only overlapped in New Harmony in 1828, this interaction may have had a lasting impact on David Dale's passion for geology (Straw & Doss 2008).

In 1836, David Dale Owen was involved with a geological survey of Tennessee conducted under the supervision of Gerard Troost (1776–1850). After completing a medical degree in 1837 from the Medical College of Ohio, David Dale Owen was appointed by the Governor to conduct a geological survey of Indiana, which was published in 1839 (Hendrickson 1943; Kimberling 1996; Johansen 1997). In addition, he was later appointed by the federal government to survey the mineral lands north and west of Indiana, which was paramount to the economic development of the Midwest (Hendrickson 1940, 1943; Johnson 1977; Kimberling 1996). In the case of these early geological reports, sketches and drawings were used to illustrate important geographic landmarks, geological features, and fossils.

Richard Owen, fourth son of Robert Owen, worked under the guidance of his older brother David Dale in 1849 to conduct a geological survey of northern Minnesota and the shores of Lake Superior. Richard, like his brother, was a proficient artist and included many sketches of geologic features in his reports. Following David Dale's death in 1860, Richard Owen continued the geologic enterprise in New Harmony (Johansen 1997; Thomas & Hannibal 2008). In 1864, he became Professor of Natural Science at Indiana University, where he taught for 15 years. He also

served as the first president of Purdue University briefly in 1872.

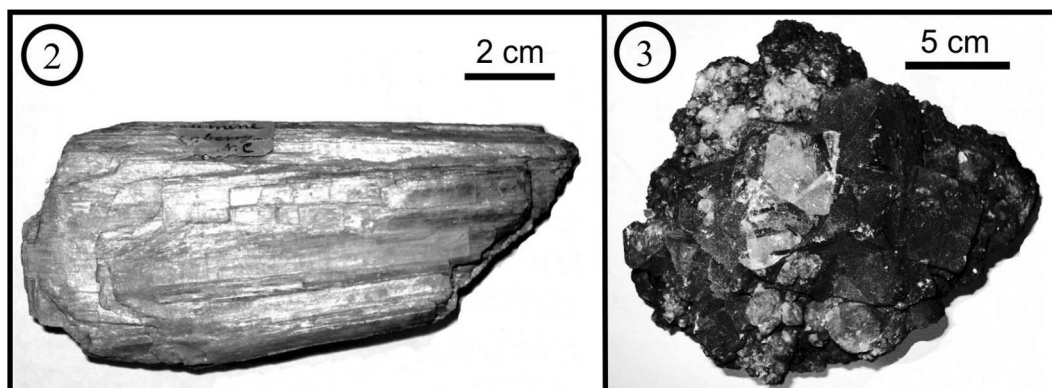
Leo Lesquereux, the "Father of American Paleobotany", worked with David Dale Owen, and later with Richard Owen, on the Pennsylvanian paleofloras of Indiana (Canright 1957). This work entailed documenting various plant fossils from Indiana, with sites in close proximity to New Harmony, such as Rush Creek and the Wabash Cutoff (Fig. 1; Canright 1957; Petzold et al. 1987). Documentation involved detailed drawings of fossil plants that were replicated in many 19th century geologic reports of Indiana (Lesquereux 1862, 1884). Illustrations have always been, and remain, key components of the paleontological sciences (Davidson 2008, p. 182–184).

Edward Travers Cox (1821–1907) served as an assistant to David Dale Owen in conducting early geological surveys of Kentucky. In New Harmony, Cox and James Sampson (1806–1890), who was a saddler, storekeeper and Maclure agent, collected and studied plant fossils from Rush Creek and the Wabash Cutoff (Fig. 1; Collett 1884; Petzold et al. 1987). From 1862 to 1868, little geological work was conducted in Indiana because of the Civil War. In 1869, the Indiana General Assembly passed an Act establishing the Indiana Geological Survey and the position of State Geologist. In accordance with this Act, Governor Baker appointed Edward Travers Cox as Indiana's first official State Geologist (Blatchley 1916). The Working Men's Institute is home to collections of Edward Travers Cox and James Sampson, with many of their geological specimens on display (Figs. 2–6).

Art, education, and geology in 19th century New Harmony established a legacy of significant natural studies. In some cases, the work of these scientists is viewed as fine art, including the work of Charles Alexandre Lesueur, David Dale Owen, and Thomas Say. The lessons learned from this synergetic educational approach may be applicable to inspiring the next generation of scientists and contribute to improving science education in the 21st century.

HISTORIC GEOLOGIC EXHIBITS IN NEW HARMONY

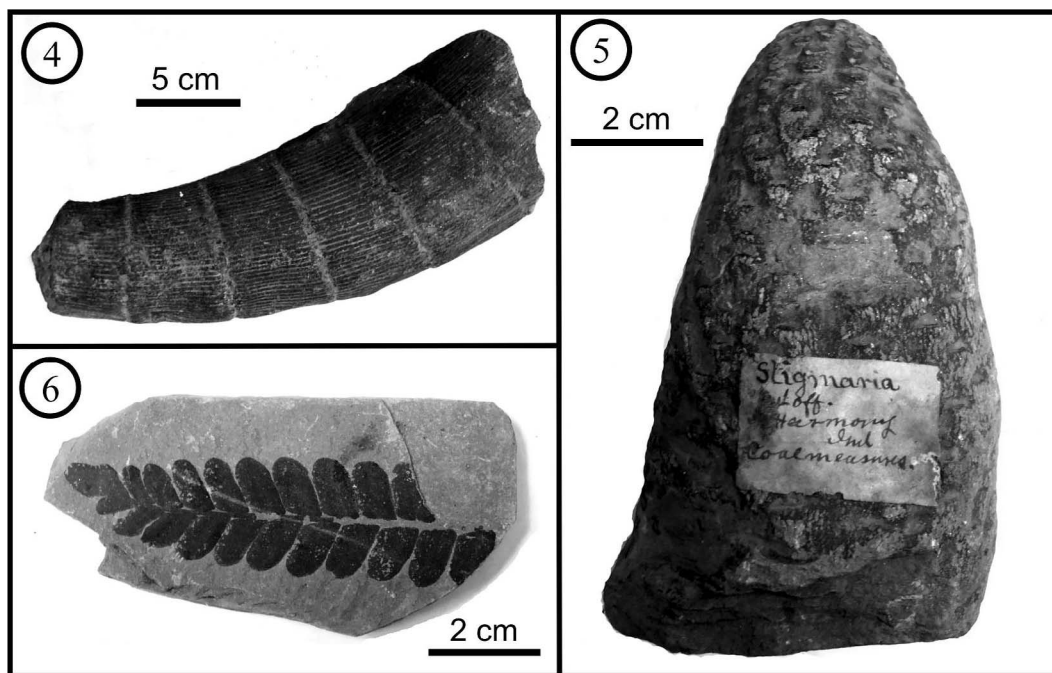
From 1834 until 1894, the WMI was located in the old Harmonist Church. With the generous support of Dr. Edward Murphy (1813–1900), who was befriended by both Robert Owen and William Maclure, a new Victorian Romanesque Revival building was constructed in 1894 and



Figures 2 & 3.—Mineral specimens from the Edward Travers Cox Collection at the Working Men's Institute in New Harmony, Indiana. 2. Specimen of kyanite from North Carolina (WMI 304.674). 3. Fluorite with quartz, unknown locality (WMI 304.671).

became the new home for the WMI (Williams, 1950). The museum portion of the WMI building contains several exhibits, including: (1) natural history collections of minerals, fossils, rocks, shells of fresh water mussels, and preserved insects, fish, amphibians, reptiles, birds, and

mammals; (2) copies of 19th century Italian art masterpieces purchased by Dr. Edward Murphy to be displayed in the museum; (3) folk art of Jacob Maental (1778–1863), who emigrated from Germany to America in 1805 and lived his last years in New Harmony; and (4) Harmonist



Figures 4–6.—Plant fossil specimens from the James Sampson Collection at the Working Men's Institute in New Harmony, Indiana. 4. Specimen of *Calamites* (WMI 300.228). 5. *Stigmaria* specimen collected from the cutoff locality near New Harmony, Indiana. Please note the original label also indicating "coal measures" (=Upper Carboniferous) (WMI 300.159). 6. Specimen of *Neuropteris* collected from the Rush Creek locality near New Harmony, Indiana (WMI 300.18).

artifacts donated to the WMI by the Harmony Society in 1914.

The natural history collections at WMI were arranged in a “discovery” style consistent with Maclure’s emphasis on learning through observation. In particular, mineral and fossil specimens were displayed with minimal labeling and grouped by donor, such as the Sampson collection or the Cox collection. Unfortunately, these exhibits provided no historical background on the importance of New Harmony to the science of geology, and minimal details were provided about the works of William Maclure, David Dale Owen, Richard Owen, and Edward Travers Cox, all prominent geologists who lived and worked in New Harmony, Indiana.

In 1979, an exhibit opened in the Keppler House highlighting the geologic studies conducted from the 19th century New Harmony, focusing on the work of David Dale Owen. In 2007, the exterior siding needed to be replaced on the Keppler House. As the old siding was removed, it was discovered that the roots of a tree growing near the building had comprised the foundation. To make repairs, the building had to be lifted from its foundation and rotted boards replaced, which required the closure of the Keppler House exhibit. During the dismantling of this exhibit, seven fossil specimens and nine printed fossil plates were transferred to the Atheneum and all other remaining items moved to storage.

With the closure of the Keppler House exhibit, plans were initiated to create a new display at WMI to highlight the historic significance of New Harmony to early 19th century geologic studies of the Midwest. This new exhibit needed to combine the original “discovery” feel of the original WMI displays, but provide narrative panels that would guide a visitor through geologic studies conducted by William Maclure, David Dale Owen, Richard Owen, and Edward Cox, as well as summarize basic geologic principles and provide relevance of modern geologic studies in the region.

NEW GEOLOGY EXHIBIT AT THE WORKING MEN’S INSTITUTE

With the loss of the exhibit in the Keppler House in 2007, a new exhibit was proposed to highlight the geologic contributions of William Maclure, David Dale Owen, Richard Owen, and Edward Travers Cox at the WMI. The design for the exhibit at WMI was developed from September 2012 to May 2014 with the assistance and support of stakeholders in New Harmony,

including the Director and Board Members of the WMI, Director of Historic New Harmony, and the Collections Manager of the New Harmony State Historic Site.

The installation of the new exhibit at WMI involved the curation and temporary removal of 125 mineral and 89 fossil specimens from seven wood trimmed glass display cases; dimensions of each of these display cases are provided in Table 1. The display cases are original to the WMI building completed in 1894, and efforts were made to preserve these cases with minor alteration (Figs. 7 & 8). All samples removed from the cases were photographed and curated prior to placing them in temporary storage in the Lilly Archive at WMI. A digital catalog was prepared, including the accession number, photograph, and a brief description of each specimen.

Using published literature and resources at the WMI, narrative panels were prepared to summarize the historic significance of New Harmony to early 19th century geologic studies. In particular, a reproduction of an 1818 geologic map of the United States compiled by William Maclure is included in the new exhibit. An original copy of this map is stored in the Lilly Archive at WMI. Additionally, a specimen of *Maclurites*, a planispiral fossil gastropod, is on display, named in honor of William Maclure by Charles Alexandre Lesueur in 1818. Additional panels in the new exhibit highlight the evolution of the geologic time scale, localities near New Harmony significant to early scientific studies, and contributions of David Dale Owen, Richard Owen, and Edward Cox to resource exploration of the Midwest United States in the early 19th century. Moreover, narratives in the exhibit highlight modern studies in southern Indiana, such as seismic monitoring of the Wabash Valley Fault Zone and flooding hazards of the Wabash River.

The new exhibit at WMI includes items once in the Keppler House and items from Historic New Harmony. Mineral and fossil samples in the new exhibit were arranged by themes: (1) mineral identification and properties; (2) crystallography of minerals; (3) ore minerals and their economic importance; (4) fluorite and associated minerals from southern Illinois and northern Kentucky; (5) plant fossils; and (6) invertebrate fossils (Table 1). Selected geologic specimens from the WMI collections were used to supplement narrative panels (Fig. 8). Eight specimens, including granite, rhyolite, blueschist, septarian concretions, and a trilobite, were loaned to WMI from

Table 1.—Dimensions and content of display cases with the new geology exhibit at the Working Men's Institute in New Harmony, Indiana.

Case	Width (cm)	Height (cm)	Depth (cm)	Content of display cases
Mineral Identification & Properties	160	81	32	Mineral properties, including hardness, color, luster, cleavage, and crystal form. Specimens displayed include apatite, calcite, corundum, fluorite, gypsum, jadeite, kyanite, microcline, muscovite, quartz, sulfur, topaz, and tourmaline.
Crystallography of Minerals	228	244	32	Early geologic studies including a reprint of Maclure's 1818 geologic map of the United States, Werner's proposed geologic history, Hutton's concept of Plutonism. Brief history of the Harmonist society, the Utopian society, and Working Men's Institute. Bottom of the case displays mineral specimens and highlights the focus on crystallography in the 18 th and 19 th centuries.
Ore Minerals & Economic Importance	160	81	32	Ore minerals and their economic importance to recovery of copper, iron, lead, and zinc. Specimens on display include: azurite, calcite, fluorite, galena, hematite, magnetite, malachite, marcasite, native copper, and sphalerite.
Fluorite Minerals from Illinois & Kentucky	226	244	62	Geologic contributions of David Dale Owen, Richard Owen, and Edward Travers Cox. Five specimens from the Cox Collection at WMI are used in this display case. Panels also highlight significant geologic localities near New Harmony, Indiana. Constructed pedestals display seven fluorite specimens probably collected from the fluorspar district of southern Illinois and northern Kentucky.
Plant Fossils	158	81	32	Eleven plant fossils from the James Sampson Collection at WMI displayed with plates of the hand drawn sketches from David Dale Owen's geologic reports.
Invertebrate Fossils: Brachiopods, Bryozoans, & Trilobites	224	244	32	James Sampson and his natural history collection, including specimens in the Smithsonian Institution. Focus on various geologic laboratories used in 19 th century New Harmony. Emphasis on the Indiana Geological Survey and the Geology program at University of Southern Indiana. Discussion of geologic hazards in southern Indiana, such as seismic risk along the Wabash Valley Fault Zone and flooding along the Wabash River. Bottom of the case displays invertebrate fossils from WMI collections.
Invertebrate Fossils: Corals & Mollusks	158	81	32	Invertebrate fossils from the WMI Collections displayed with plates of the hand drawn sketches from David Dale Owen's geologic reports. Includes specimen of <i>Maclurites</i> , named in honor of William Maclure by Charles Alexandre Lesueur in 1818.



Figures 7 & 8.—Before and after photographs of one of the large display cases on the second floor of the Working Men’s Institute in New Harmony, Indiana. 7. Case before construction of new exhibit with unlabeled mineral specimens. Note that the shelving is not original to the display case. 8. Display case after installation of the new exhibit with specimens integrated with the narrative panels (arrows).

the geology collections at the University of Southern Indiana. The exhibit was completed in August 2014 for the New Harmony bicentennial celebration.

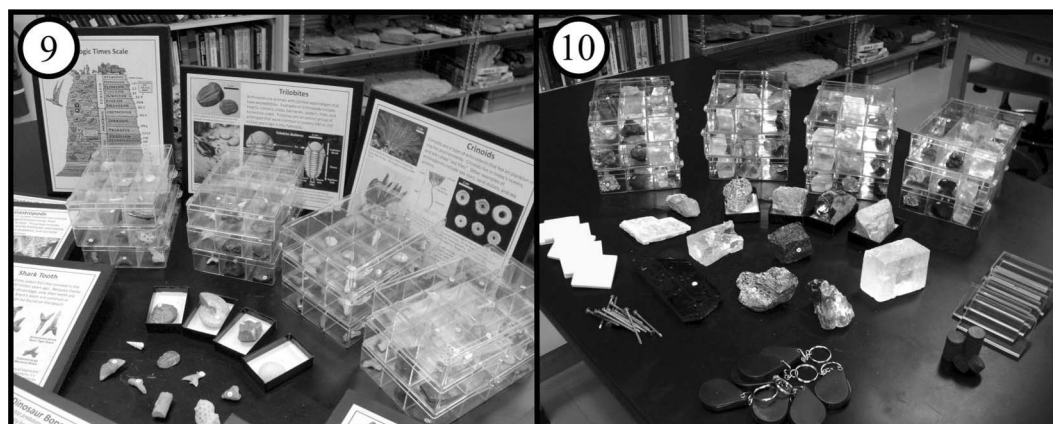
In addition to the new exhibit at WMI, two hands-on teaching kits were prepared for use by K–12 teachers and visitors to WMI. One kit focuses on mineral identification, and the other on fossil identification (Figs. 9 & 10). The mineral kit contains: (1) 12 cases of 12 minerals each; (2) 20 magnets; (3) 20 streak plates; (4) 20 glass plates; (5) 20 steel nails; and (6) 20 hand lenses (10×). The fossil kit contains: (1) 12 cases of 12 fossils each; (2) educational panels showing important features of each fossil group; and (3) 20 hand lenses (10×). Teaching guides accompany the kits to provide teachers with background information, identification keys, and suggestions for hands-on activities. The kits and activities are aligned with the specimens on display in the new exhibit and focus upon students conducting hands-on activities that involve sketching. Each kit is packaged in a plastic tub that may be easily transported.

These kits are available for check-out from the WMI in New Harmony, Indiana.

IMPORTANCE OF SKETCHING TO LEARNING SCIENCE

Illustrations were paramount to scientific discovery and documentation in the early 19th century, especially prior to portable photography (Rudwick 1976; Davidson 2008, p. 45–46; Johnson 2008). In the 20th century, photographs became pervasive in introductory science textbooks and 35 mm slide shows were commonplace in the introductory science classroom. In the 21st century, software and audiovisual projectors have resulted in pervasive expansion of digital slide presentations in the introductory science classroom.

In the past decade, many studies have focused on active learning and increasing student interest in science, as well as improving performance in the classroom (Lorenzo et al. 2006; Haak et al. 2011; Henderson et al. 2011; Freeman et al. 2014). Sketching is one active tool that improves



Figures 9 & 10.—Teaching kits available at Working Men’s Institute. 9. Fossil kit with sample sets and instructional panels. 10. Mineral kit with sample sets and mineral testing materials. Both kits are accompanied with lesson plans and teaching guides.

cognitive retention of scientific principles (Lane et al. 2009; Ainsworth et al. 2011). Ainsworth et al. (2011) outlined five reasons learning by drawing is a key component to science education: (1) enhances engagement; (2) offers representations of scientific processes; (3) promotes reasoning in science; (4) affords a unique learning strategy; and (5) encourages communication. Likewise, concept-sketches are used in textbooks and by instructors to assist students in learning earth science processes, such as plate tectonics, relative dating, and paleontology (Johnson & Reynolds 2005; Yacobucci 2012).

Interestingly, the synergetic approach to education proposed by Robert Owen and William Maclure in the early 19th century aligns with the goals of active learning and the importance of sketching to science comprehension by students. The unique visual language that emerged in the early 19th century led to significant progress in the natural sciences, especially geology (Rudwick 1976). In the modern world, Arnheim (1969) concluded that this graphicacy, visual and graphic skills, remains as important to education as literacy and numeracy. Geology provides a unique opportunity for students to learn visual and graphic skills, and the discipline has a rich history of using illustrations and maps in scientific publications (Rudwick 1976). Furthermore, sketching by students has been an important component to teaching invertebrate paleontology in the 19th and 20th centuries, and continues to be an important pedagogical method.

Recent studies have emphasized the importance of sketching and visual-spatial skills in education for the purpose of increasing comprehension of basic scientific principles (Mathewson 1999, 2005; Jee et al. 2014), and to geology specifically (Johnson & Reynolds 2005; Martínez-Peña & Gil-Quílez 2014). Thus, it is vital to encourage students to sketch in the science classroom in order to gain important visual-spatial skills and to demonstrate understanding of scientific concepts gained through focused observation (Mogk & Goodwin 2012). As part of the new geology exhibit at the WMI, fossil and mineral kits provide students with an opportunity to conduct hands-on activities that require sketching and engage students with visual-spatial exercises (e.g., building models).

In addition to sketching, Mueller & Oppenheimer (2014) have concluded students that take handwritten notes are more likely to retain information than those students relying on technology, such as laptops, cameras, and/or smartphones. This suggests that students should be encouraged to take handwritten notes in the science classroom, while also providing an opportunity for students to draw sketches. In geology, notetaking and sketching are especially important to field notebooks and recording field observations.

The progress toward incorporating more sketching in the science classroom begins with engaging K–12 teachers with active learning. Almquist et al. (2011) developed an integrated field-based approach to enhance geoscience skill



Figure 11.—Participants in the USI day camp in June 2015 involved with activities using the mineral kits prepared for the Working Men’s Institute.

sets of teachers. Specifically, this field experience was designed to enhance spatial visualization through detailed study of stratigraphic sequences. They practice three visual skills that are particularly important to geologists (Titus & Horsman 2009): (1) spatial relations; (2) spatial manipulation; and (3) visual penetrative ability. Thus, active learning activities that incorporate these spatial visualizations are important to the engagement of teachers and the transfer of more visual learning to their science classrooms.

As part of the new exhibit at the WMI in New Harmony, the fossil and mineral kits provide K–12 teachers an opportunity to incorporate active learning into their science classrooms. Through lesson plans and guides provided with the kits, teachers are encouraged to require students to maintain a field notebook, build models, and sketch for the purpose of understanding key scientific processes and concepts. Additionally, day camps and visitors to the WMI may use these kits for educational activities in New Harmony (Fig. 11). Active learning approaches such as these

have been found to increase student interest in pursuing science degree programs and careers (Watkins & Mazur 2013; Xu 2013; Freeman et al. 2014; Maltese et al. 2014).

SUMMARY

The new geology exhibit at WMI and the related hands-on teaching kits provide regional K–12 teachers with an important resource. The new exhibit and teaching kits follow the tradition of the Pestalozzian method and align with the original goals established for the WMI by Maclure in 1838. Furthermore, the development and installation of the new geology exhibit at WMI provides a unique outreach activity for faculty members and undergraduate students at the University of Southern Indiana. The new exhibit, a fitting replacement for its predecessor in the Keppler House, provides a vital addition to New Harmony. Visitors can learn more about the connections of New Harmony to the 19th century geologists whose studies in the Middle West America shaped that science. Finally, community

outreach activities and new Museum exhibits are vital to expanding the visibility of and creating public interest in the natural sciences, especially in geology and the earth sciences.

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