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Attendees of the First Field Conference of Pennsylvania Geologists in 1931 included Eleanora Bliss Knopf (front row, fifth from the left) and Anna Jonas Stose (front row, sixth from the left). At the time, women were discouraged from becoming geologists, but some of them persevered and produced important contributions to the field. Today, a large percentage of geologists are women, many of whom have made notable achievements and serve in leadership roles. (See article on page 3 and compare with photograph on page 16.)

EDITORIAL

Women in the Geosciences

Gale C. Blackmer, State Geologist
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We've come a long way since Florence Bascom had to sit behind a screen in her classes at Johns Hopkins University so her presence wouldn't distract the men (I've always thought that said more about the men than about her). Now women geoscientists can be found everywhere, from laboratories, field stations, and university classrooms to boardrooms, high offices at the U.S. Geological Survey and state geological surveys, and even in space (read this AEG blog post for some interesting stories). It took a while to get here, though. When I was in college and graduate school in the 1980s, it was still not unusual to be the only woman in a class. I had women as professors at Penn, but Penn State's Department of Geosciences hired its first women while I was there. The first woman state geologist was Genevieve Atwood in Utah, appointed in 1981. Incidentally, Atwood was a Bryn Mawr College graduate. The 1980s seemed to be the time when women started to gain critical mass. Now, undergraduate enrollments are something like 50–60 percent women, although the numbers decrease with advanced degrees and promotion through the workforce. There are currently eight women state geologists. Our bureau is now 60 percent women in technical positions. We should celebrate all these advances!

But there is still work to be done. Although overt gender discrimination is more difficult these days, unconscious bias and microdiscrimination is still common and can hamper women's advancement in the workforce (read this article in Eos for more information). There are also stories of sexual harassment that will make your blood run cold. The risk of those situations keeps some women from pursuing careers that involve time in the field or in close collaboration with male colleagues. The situation appears to improve with every generation, although we must all continue to be vigilant about our own biases and the safety of our colleagues.

Pennsylvania has had its share of prominent women geologists. You'll read about some of them in the lead article in this issue (next page). There are many others who fought for their positions and for their work so that today's women can be where we are. Let's salute and celebrate them all!

Gale C. Blackmer

Past and Present—Some Outstanding Women Geologists of Pennsylvania

Katherine Schmid, Michele Cooney, Gale Blackmer, Christopher Oest, and Antonette Markowski
Pennsylvania Geological Survey

INTRODUCTION

In honor of Women's History Month, it is important to highlight the careers of some of the women geologists in Pennsylvania who have furthered the science of geology, acted as mentors, and paved the way for future female geologists, both in education and in work for state geological surveys and the U.S. Geological Survey (USGS). A timeline summarizing information about the women who are featured in this article and their accomplishments (Figure 1) is included on the following page.

FLORENCE BASCOM

Florence Bascom, born in 1862 in Williamstown, Mass., has since become known as "the first woman geologist" in the United States. She was the second woman in this country to earn a Ph.D. in geology and the first woman hired by the USGS (Schneiderman, 1997). While a student at Johns Hopkins University, Bascom was required to sit behind a screen in a corner while attending classes (Arnold, 1983; Schneiderman, 1997). Although she was treated differently because of her gender, she completed her dissertation on volcanic rocks of South Mountain in Pennsylvania (Bascom, 1896) and received her Ph.D. in June of 1893 (Arnold, 1983; this reference also provided much of the information included in this and the next paragraph). From 1893 to 1895, Bascom taught at the Ohio State University. In 1895, she was recruited to teach at Bryn Mawr College, a women's liberal arts college in southeastern Pennsylvania that had been founded in 1885, where she established the geology department. She continued teaching there until 1928. While teaching at Bryn Mawr, in 1896 Bascom started working for the USGS. As a geologist, Bascom typically spent her summers in the field—traveling by horse and buggy or on foot—and spent her winters working in her laboratory. Her assigned work was researching the crystalline schists in eastern Pennsylvania and Maryland, northwestern Delaware, and in the area of Trenton, N.J. Through her teaching career, Bascom mentored other women geologists, some of whom later worked in Pennsylvania, including Anna Isabel Jonas and Eleanora Frances Bliss.

ANNA ISABEL JONAS AND ELEANORA FRANCES BLISS

Anna Isabel Jonas (see photograph on page 20) was born near Cape May, N.J., in 1881 (Arnold, 1983). Jonas graduated from Bryn Mawr in 1904 (bachelor's degree) and 1905 (master's degree) and published her first paper on serpentine in the Philadelphia area in 1905. From 1905 to 1906, she worked in Bryn Mawr's geological laboratories, and in 1908–09, she worked as an assistant curator in Bryn Mawr's geological museum. Jonas' colleague, Eleanora Frances Bliss, was born in Pennsylvania in 1883. In 1904, Bliss graduated with degrees in chemistry and geology from Bryn Mawr. During their time at Bryn Mawr, Bliss and Jonas prepared a joint dissertation on the Doe Run-Avondale region in Pennsylvania, just west of Bryn Mawr College, working on two different aspects of the research. They were awarded doctoral degrees for this work in 1912. Bliss worked for the USGS as an assistant from 1912 until 1955. Jonas worked as a staff member of the American Museum of Natural History from 1916 to 1917 and began working for the Pennsylvania and Maryland geological surveys in 1919. In

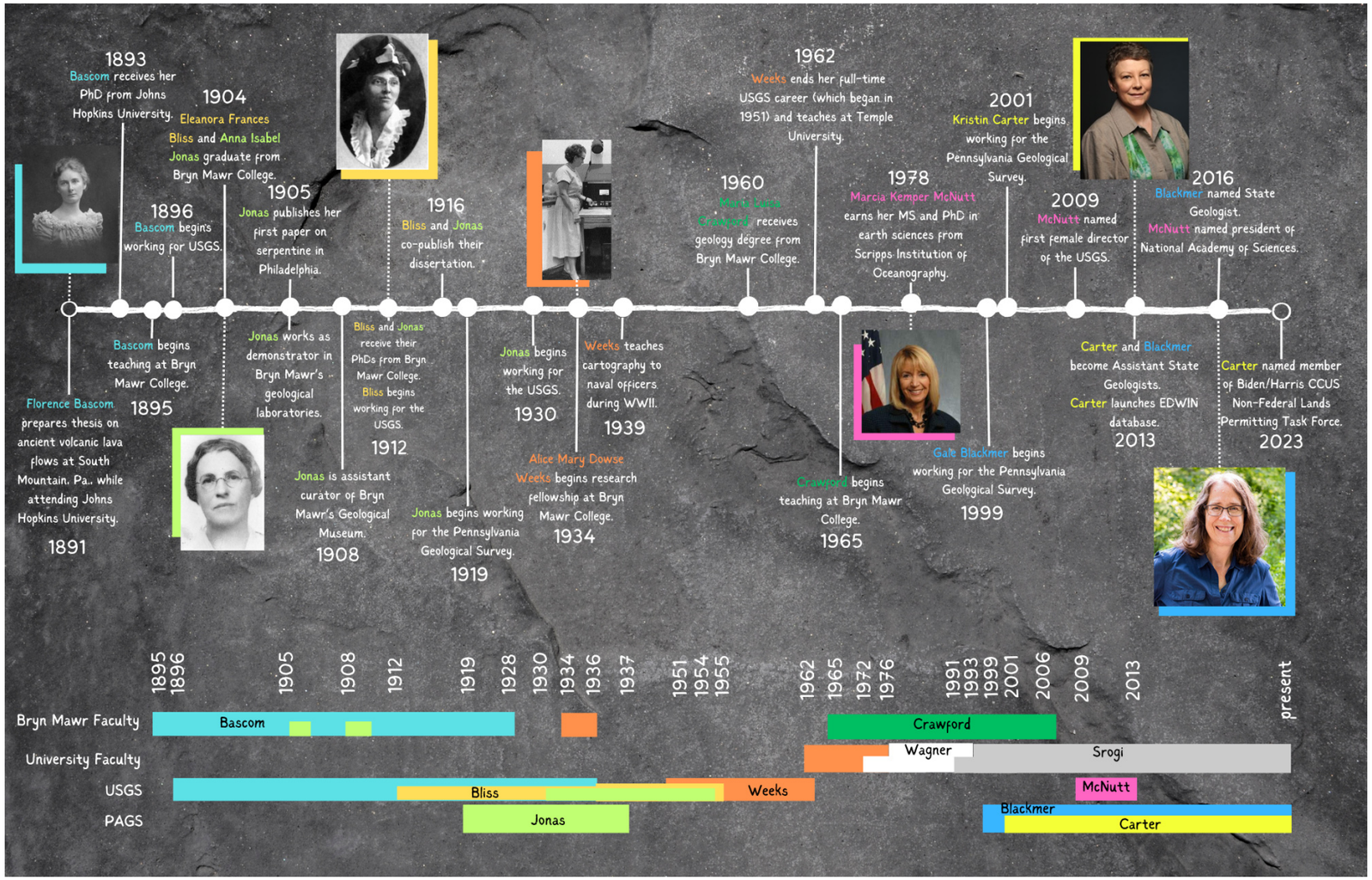

Figure 1. This figure displays a timeline that includes some of the important women in the history of the study of Pennsylvania's geology, and some of their accomplishments. The color bars indicate the length of time that each woman occupied a position. The photographs, from left to right, show Florence Bascom (from Anderson, 2023), light blue; Anna Jonas Stose (from Kelly, 2021), yellowish-green; Eleanora Frances Bliss Knopf, (from U.S. Geological Survey, 2024a), gold; Alice Mary Dowse Weeks (from Wikipedia, 2023), orange; Marcia Kemper McNutt (from U.S. Geological Survey, 2024b), pink; Kristin Carter, yellow; and Gale Blackmer, blue. The remaining color bars represent others mentioned on page 6, not pictured: Maria Luisa Crawford, green; Mary Emma Wagner, white; and LeeAnn Srogi, gray.

1920, Bliss married another geologist, Adolf Knopf, and moved with him to New Haven, Conn., when he was offered a professorship at Yale University (Rodgers, 1977). At this time, Dr. Eleanora Bliss changed her name to Dr. Eleanora Knopf.

Despite their separate career paths, the above three women worked together on numerous mapping projects in southeastern Pennsylvania and Maryland in the 1920s. On many of these projects, they worked with George Stose, who held the position of Editor of Geologic Maps in the USGS. They described anticlines, synclines, and faults based on what they observed in outcrop and mines, or from shallow water wells. Much of the dating and formation correlations were done by fossil identification. In her 1905 report on the Piedmont district of Pennsylvania, Bascom had noted the need for getting more accurate ages of rocks to better constrain the timing of events (Bascom, 1905).

In 1923, Knopf and Jonas described outcrops of Precambrian and Cambrian metamorphic rocks in southeastern Pennsylvania and Maryland (Knopf and Jonas, 1923). They determined Cambrian ages for the bedrock by identifying fossils where they were present, though in some cases the fossils were too deformed by metamorphism to be identified. They also observed multiple grades of metamorphism in this area. Knopf and Jonas discussed several theories of metamorphism that existed at that time. They concluded that "The variations in intensity of metamorphism in the region can only be explained by the operation of several causes, operating at different times" (Knopf and Jonas, 1923, p. 62). This observation did not support Hans Stille's 1922 theory that all folding phases occurred at the same time around the world. Later geologists commented on the findings of Stose and Jonas and how close to right they were despite the hostile intellectual environment. MacLachlan (1994) credited Jonas with being the source of these revolutionary ideas. Jonas worked with George Stose on many geologic problems. They coauthored many papers from 1922 to 1957. In the middle of this time, in 1938, Anna Jonas married Stose (Dietrich, 1977) and changed her name to Dr. Anna Stose.

ALICE MARY DOWSE WEEKS

Alice Mary Dowse Weeks may not be a name that is as recognizable as the women discussed earlier in this article; however, her contribution to the geosciences is no less significant. Alice Weeks faced adversity early in her career. She began graduate school in 1934 and, like Florence Bascom, was not permitted to attend certain courses simply because she was a woman. Weeks defied this policy by sitting outside the classroom door to take notes during lectures. Before returning to graduate school for her doctorate, Weeks worked for a year as a research assistant and laboratory instructor at Bryn Mawr College less than a decade after Bascom retired from teaching at the same institution. Although Weeks' career focused on mineralogy, she demonstrated her wide-ranging talents as a geologist by mapping two 7.5-minute quadrangles near her hometown of Sherborn, Mass. World War II interrupted her graduate studies—fuel rationing prevented her from finishing the field work necessary for completing her quadrangle mapping. She was not idle during this time, however, because she used her mapping skills to teach naval officers how to make maps (Dowse, 1988).

Following graduate school, Weeks was employed by the USGS, where she focused on characterizing uranium and vanadium ore minerals found in the Colorado Plateau. During this time, she made significant contributions to the understanding of these ores (see Weeks, 1953; Weeks and others, 1955; and Weeks and others, 1956) and again overcame hardships rooted in sexism. In some instances, Weeks had to pose as a man in order to access mines to collect samples for her research. In recognition of her contributions to the understanding of uranium ores of the Colorado Plateau, the uranium silicate mineral "weeksite" was named in her honor (Outerbridge and others, 1960).

Weeks' primary connection to Pennsylvania occurred in 1962, when Temple University enlisted her to create the Department of Geology. When she arrived, the program consisted of one instructor providing an introductory geology course to more than 1,000 students (Dowse, 1988). Weeks quickly expanded the program by hiring four other faculty members who taught 12 courses to undergraduates and master's degree students by 1967 (Temple University Department of Earth and Environmental Science, 2024). Weeks retired in 1976, but the department that she started and that benefited as she fostered its initial growth has continued to expand. Today, the department offers a wide variety of courses focusing on both geological and environmental sciences. Weeks' legacy lives on at Temple, because a donation from Weeks and her husband established an endowed chair in the department that bears her name. Her story has inspired generations of women geoscientists and will continue to do so.

MARIA LUISA CRAWFORD

Another woman geologist who followed in Bascom's footsteps was Dr. Maria Luisa Crawford. Crawford received her bachelor's degree in geology from Bryn Mawr College in 1960. She obtained her doctorate from the University of California at Berkeley in 1965 and then returned to Bryn Mawr College to teach geology (MacArthur Foundation, 1993). Crawford was a consummate field geologist and 1993 MacArthur Fellow, an expert in metamorphic petrology and tectonics who worked in areas as disparate as Pennsylvania and Alaska. She and her Bryn Mawr students produced many field studies that advanced our understanding of the metamorphic and tectonic history of the Piedmont. Crawford retired from Bryn Mawr in 2006. One of her students, Mary Emma Wagner, was the current Pennsylvania State Geologist's (Gale Blackmer) petrology professor when Blackmer was an undergraduate at the University of Pennsylvania in the early 1980s. Wagner and one of her students, LeeAnn Srogi, continued work on the metamorphic history of the Pennsylvania-Delaware Piedmont. Srogi later became a professor at West Chester University in Pennsylvania and an important part of the Pennsylvania Geological Survey's Piedmont mapping effort in the 2000s.

MARCIA KEMPER MCNUTT

Moving to more recent times, Marcia Kemper McNutt received her Ph.D. from the Scripps Institution of Oceanography in 1978 (Aguilera, 2015). McNutt did not work in Pennsylvania, but it is interesting to note that she was the first female director of the USGS in its 130-year history. Florence Bascom was the first woman to work for the USGS in 1896, but despite this long history of hiring women, the USGS did not have a woman leader until 2009 when President Obama nominated McNutt as director. McNutt served in this position from 2009 to 2013 (Aguilera, 2015). As USGS director, her goal was to make the agency "less bureaucratic and more responsive to science objectives." As science advisor to the secretary of the Department of the Interior from 2010 to 2013, McNutt spoke in favor of funding water programs, stream gage networks, and the assessment of underground carbon storage capacity (Straub, 2009). McNutt responded to four major disasters, including the *Deepwater Horizon* oil spill, when she headed the Flow Rate Technical Group to determine the extent of the spill. For her efforts on this work, she was awarded the U.S. Coast Guard's Meritorious Service Medal. After working for the USGS, McNutt became the first female president of the National Academy of Sciences from 2016 to 2022 (Aguilera, 2015).

KRISTIN CARTER

Kristin Carter started with the Pennsylvania Geological Survey in 2001. Since then, she has worked in the Pittsburgh office of the bureau, where the focus is primarily on subsurface and petroleum geology.

In 2008, Pennsylvania's Act 129 required the Pennsylvania Department of Conservation and Natural Resources to conduct a series of studies related to geologic sequestration of carbon dioxide in the commonwealth. In response to this, Carter has spent much of her career working on reservoir characterization and carbon capture, utilization, and storage (CCUS) research, bringing hundreds of thousands of federal dollars into the bureau. Much of this work has been done in collaboration with other states in addition to the federal government. In 2013, she was named Manager of the Geologic Resources Division and Assistant State Geologist. That same year, she launched the Exploration and Development Wells Information System (EDWIN), which continues to serve as the state's premier database for compiling oil and gas well data. Since 2019 she has served as State Lead on Pennsylvania's CCUS Inter-Agency Work Group and was invited to serve on the Biden/Harris administration's Carbon Dioxide Capture, Utilization and Sequestration Non-Federal Lands Permitting Task Force. Carter has served and continues to serve as a mentor to many students, interns, and young professionals.

GALE BLACKMER

Dr. Gale Blackmer began working with the bureau in 1999, the first woman hired specifically as a field mapper since Anna Jonas Stose. She started as a Geologist 1 with the primary responsibility of mapping the metamorphic rocks of southeastern Pennsylvania. Her first Piedmont map was the Coatesville quadrangle (Blackmer, 2004). Her fieldwork pointed toward significant changes from Bascom and [George] Stose's (1932) Coatesville-West Chester folio. To gain insight into the reasoning behind that historic map, Blackmer visited the Bryn Mawr College library to examine Bascom's field notes and hand-colored draft maps. She discovered that her map was quite similar to Bascom's draft maps. Letters between Bascom and Stose, also preserved in the Bryn Mawr archival collection, indicated that Stose disagreed with Bascom's original map. The final map was apparently based more on his ideas of what the map should look like than on geologic observations. Even though Bascom had done the fieldwork, Stose was the boss, and his interpretations took precedence.

In 2002, Geologic Mapping Division management placed the Piedmont project into STATEMAP, a USGS grant program that provides federal matching funds to state geological surveys for geologic mapping and mapping-related work. Blackmer started with developing the proposal and budget for the Piedmont project, and by 2004 had taken over responsibility for the entire STATEMAP proposal, bringing in $150,000 per year on average. The Piedmont project was tremendously successful; it involved assembling a working group of academic geologists and working closely with the Delaware Geological Survey to remap and reinterpret the geology and geologic history of the central Appalachian Piedmont. Blackmer rose through the ranks to become Manager of the Geologic Mapping Division in 2010. From 2013 until 2015 she served as Assistant State Geologist alongside Carter. In 2015, she was named Bureau Director and State Geologist, the first woman to hold those positions. She now serves as Chair of the Mapping Committee for the Association of American State Geologists, where she works closely with the USGS National Cooperative Geologic Mapping Program to help ensure that the program brings the greatest benefit to the states and the USGS. Maintaining the bureau's hand in topographic mapping, she serves as vice-chair of the 3DEP Subcommittee of the National Geospatial Advisory Committee. In 2021, she was named a Fellow of the Geological Society of America and a 125th Anniversary Fellow of the Penn State College of Earth and Mineral Sciences. Blackmer has influenced a multitude of female students as an instructor at Penn State, Dickinson College, Bloomsburg University, and West Chester University, and continues to work with students and the public through a variety of outreach activities.

SUMMARY

In summary, Pennsylvania has a long history of influential women geologists. Florence Bascom, the woman known as the first woman geologist in the United States, got her start in this region. Bascom influenced future women geologists both as an educator and as a geologist working for a government agency. Today, more than half of the Pennsylvania Geological Survey staff identify as women, including the first female State Geologist and Assistant State Geologist.

In teaching and starting a geology department at a Pennsylvania women's college, Florence Bascom has inspired generations of women scientists and educators in this region. Before obtaining her doctorate, Alice Mary Dowse Weeks worked at Bryn Mawr as a research assistant and laboratory instructor. Weeks went on to found a geology department at Temple University in Pennsylvania. A later geology professor at Bryn Mawr, Maria Luisa Crawford, taught Mary Emma Wagner, who later became a geology professor at the University of Pennsylvania. Wagner taught LeeAnn Srogi, currently a professor at West Chester University in Pennsylvania, and Gale Blackmer, who is currently the State Geologist of Pennsylvania. Blackmer notes that despite being the first woman hired as a geologic mapper by the bureau in decades, she did not feel out of place, because many of the maps she used as references in her work were authored by women, some of whom are mentioned here.

All the women geologists included in this article have made countless contributions to the science of geology, far more than discussed in this brief article. Carter and Blackmer, along with many other notable women in the bureau and other Pennsylvania institutions, continue to reshape and further the science of geology.

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Modeling Bedrock Elevation of Pennsylvania Using an Adaptive GIS Methodology—The First Steps Toward a Three-Dimensional Geologic Model of Pennsylvania

Alfred C. Guiseppe
Pennsylvania Geological Survey

BRAVE NEW 3D WORLD

The Pennsylvania Geological Survey has embarked on a new endeavor to create a 3-dimensional (3D) geologic model of Pennsylvania in support of the U.S. GeoFramework Initiative (a partnership between the U.S. Geological Survey and state surveys). The bureau is creating digital elevation models of major geologic bounding surfaces. As a first step, the bureau developed a digital surface that represents the bedrock elevation beneath unconsolidated sediments. Over the years, geologists have used subsurface data from water wells, geotechnical borings, and seismic surveys to map the bedrock elevation. The historical process of generating a bedrock elevation map, which involves contouring the data by hand, is a laborious process and subject to radical changes in interpretation whenever new data are collected. Using digital mapping techniques, geostatistical analysis, and GIS (Geographic Information Systems) workflow models, the newly developed method to generate a bedrock elevation surface has shifted away from time-consuming manual efforts and toward automated computer processing, which allows for the rapid update of this surface as new data are collected.

GEOFRAMEWORK INITIATIVE

Geologic mapping forms the bedrock of geological understanding, offering insights into the complex interplay of Earth's processes and features. The current effort by the bureau to establish a 3D geologic model of Pennsylvania underscores the contemporary fusion of geoscience and geospatial technology. As a pivotal starting point, in this article the author delves into the innovative methodology adopted for modeling bedrock elevation beneath unconsolidated sediments, showcasing the efficacy of adaptive GIS techniques and computational automation.

At the heart of this endeavor is the U.S. Geoframework Initiative, which aims to integrate detailed national- and continental-resolution 2D and 3D geologic information produced by federal and state partners. The first step toward this goal is to create a 3D surface representing the top of bedrock beneath the unconsolidated sediments of Pennsylvania.

Traditionally, bedrock-elevation and drift-thickness maps were hand-contoured by geologists using subsurface data obtained from water wells, geotechnical borings, and seismic surveys (Figure 1). This manual process was not only labor intensive but also susceptible to significant reinterpretation whenever new data emerged. In contrast, the advanced approach recently developed by the bureau leverages contemporary tools such as digital mapping techniques, geostatistical analysis, and an iterative GIS workflow model. This departure from traditional methodologies has provoked a paradigm shift, transitioning from time-intensive manual processes to automated computational processing. As a result, this methodology allows efficient real-time updating of the bedrock elevation model, rendering it adaptable and responsive to the dynamic acquisition of new data.

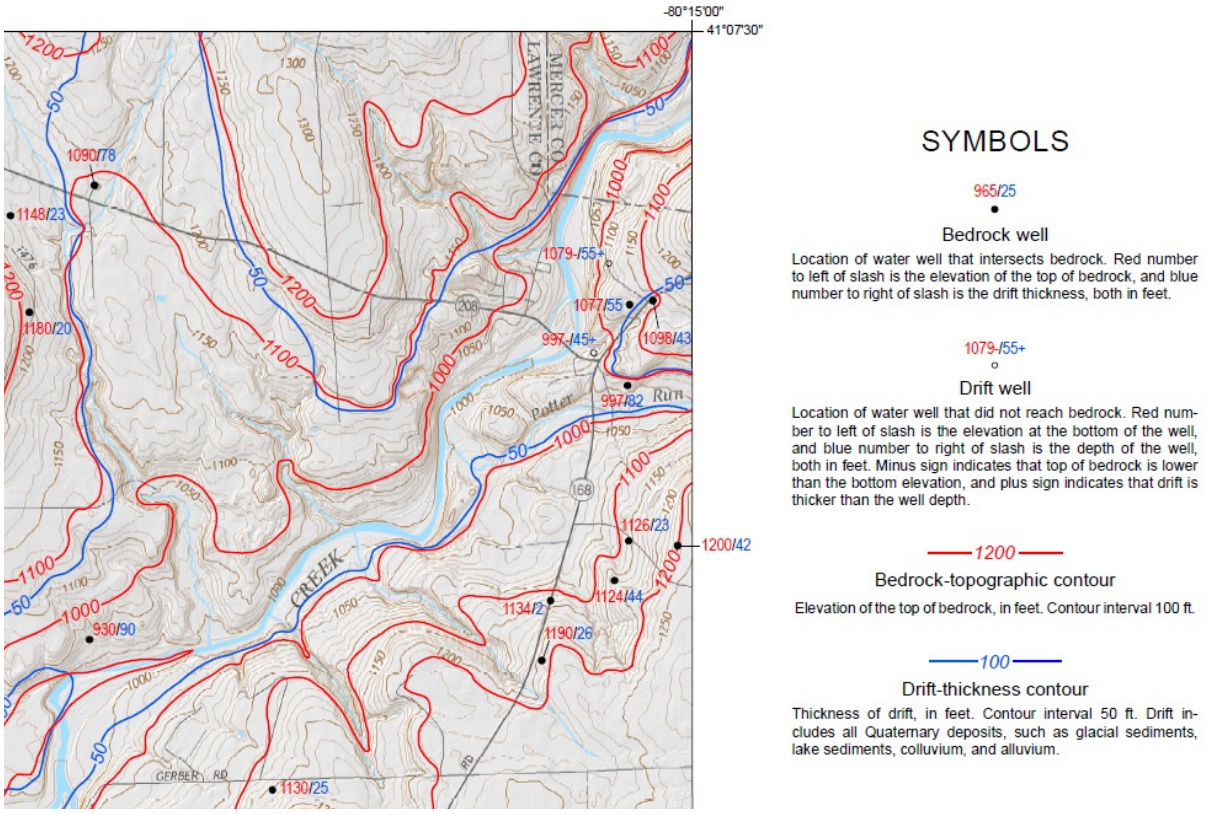

Figure 1. The northeastern portion of the bedrock-topography and drift-thickness map of the New Castle North 7.5-minute quadrangle in Lawrence and Mercer Counties, Pa. (Reese and others, 2022).

WATER-WELL DATA

The Pennsylvania Geological Survey assembled more than 214,000 relevant water-well records from the Pennsylvania Groundwater Information System (PaGWIS) and borehole data used in the pilot project covering the glaciated portion of northwestern Pennsylvania (Figure 2). Although the density of water wells varies across the state, data coverage extends across all physiographic sections and major topographic landforms found within Pennsylvania. Each well record used in the analysis contains a measurement of the depth to bedrock (in feet) or a notation indicating that bedrock was not encountered during well drilling. For the purpose of determining the thickness of unconsolidated sediments, the well records are separated into two datasets—bedrock wells (wells that penetrate bedrock) and drift wells (wells that did not encounter bedrock). Using these data, the bureau interpolated a sediment-thickness model of the state. The initial results were inconsistent, subject to variations in spatial data density. An approach was needed to help fill in the gaps.

TOPOGRAPHIC POSITION INDEX

The project team used physiographic section and a topographic position index (TPI) to identify the landform type in which each well resides. TPI is a quantitative landform analysis that uses land surface elevation data to determine landforms such as ridge, upper slope, middle slope/flats, lower slope, and valley. Although the concept of classifying landforms based on contour maps has been widely applied

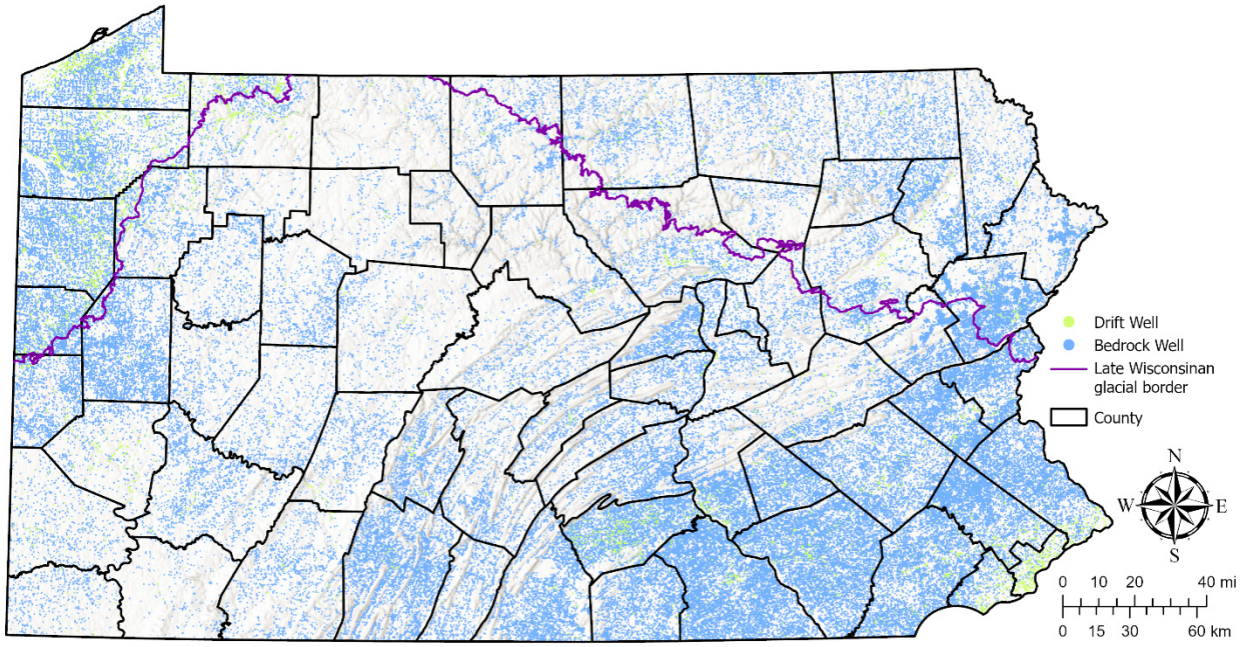

Figure 2. Geographic distribution of water-well data points used in the analysis.

through various techniques, a modern GIS application of TPI was presented at an Esri (Environmental Systems Research Institute, which has developed powerful GIS software) International User Conference by Weiss (2001). A variation of the Weiss method was used to generate a composite TPI raster of Pennsylvania for the purposes of this project (Figure 3).

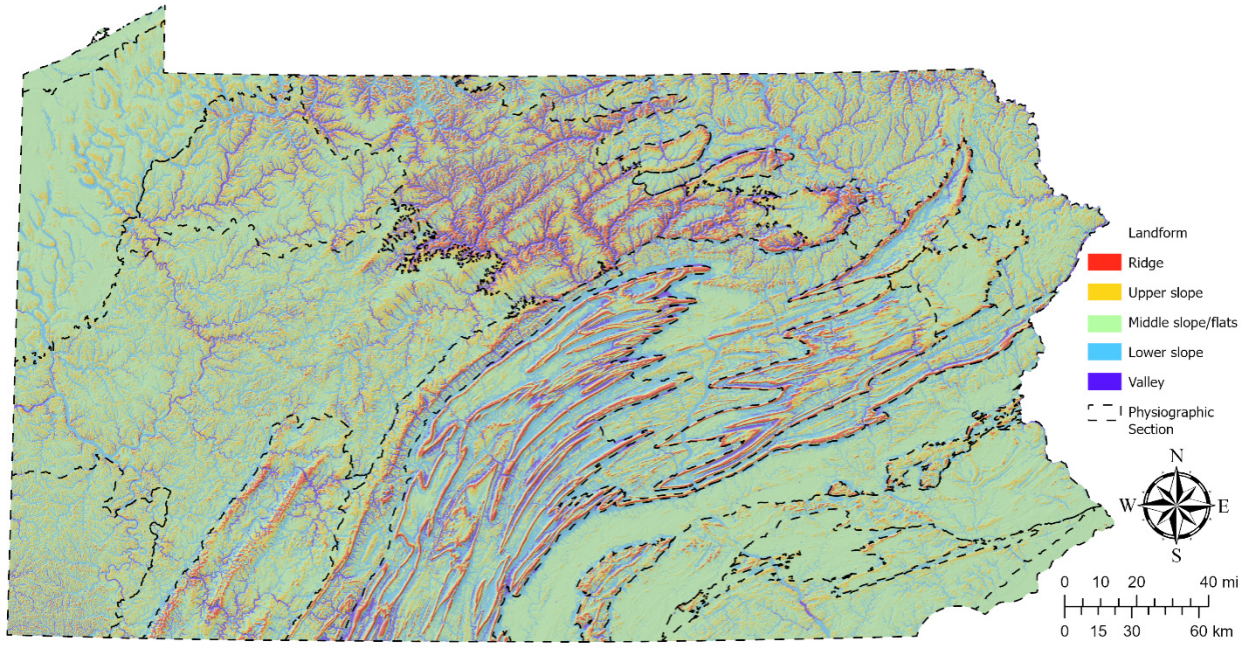

Figure 3. Classification of landforms by topographic position index.

STATISTICAL RELATIONSHIP ESTABLISHMENT

The heart of the methodology resides in the statistical relationship between TPI and the sediment thickness specific to individual physiographic sections (Figure 4). This relationship, supported by geostatistical principles, produced a surrogate model. Here, "surrogate model" refers to a set of predictive data; specifically, projected sediment thicknesses in regions characterized by sparse empirical data.

ITERATIVE REFINEMENT

The surrogate model was created by using landform-based statistics to generate "synthetic" data points in order to fill in gaps in empirical data coverage. An iterative refinement process, through assimilation of empirical well data and synthetic points derived from the surrogate model, produced an adaptable sediment thickness model that bridges empirical observations and predictive analytics. An interpolated sediment thickness model was generated based on more than 400,000 data points, including bedrock wells, drift wells, and synthetic points (Figure 5).

CONDITIONAL SMOOTHING TECHNIQUES

The sediment thickness model was resampled to conform to a similar resolution surface topography digital elevation raster. Through this process of raster resampling, the sediment thickness raster adopts the same projected coordinate system, cell size, and cell position as the surface elevation raster. As discussed in Soller and Garrity (2018), the surface elevation raster needs to be smoothed to remove detail before subtracting the sediment thickness to create a bedrock elevation raster. The degree of smoothing was applied proportionally to the magnitude of sediment thickness. A 100-meter grid bedrock elevation raster was calculated by subtracting the resultant sediment thickness raster from the conditionally smoothed surface elevation raster.

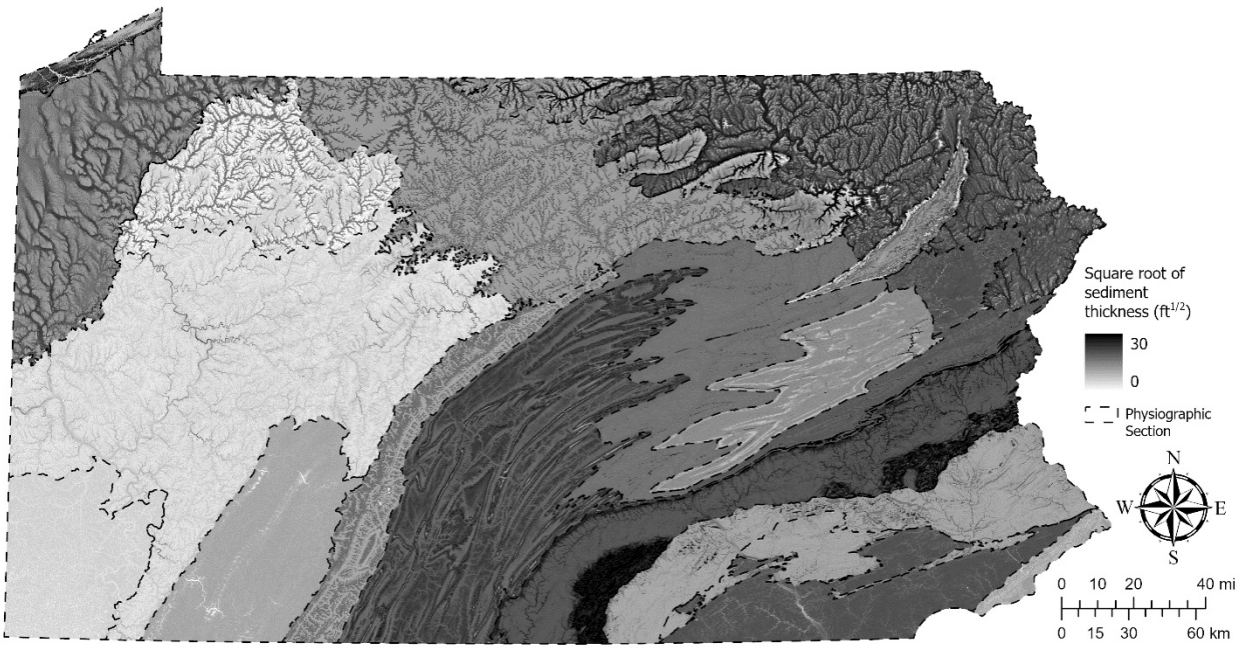

Figure 4. The statistical relationship between bedrock depth and topographic position index for each physiographic section yields a surrogate model of sediment thickness.

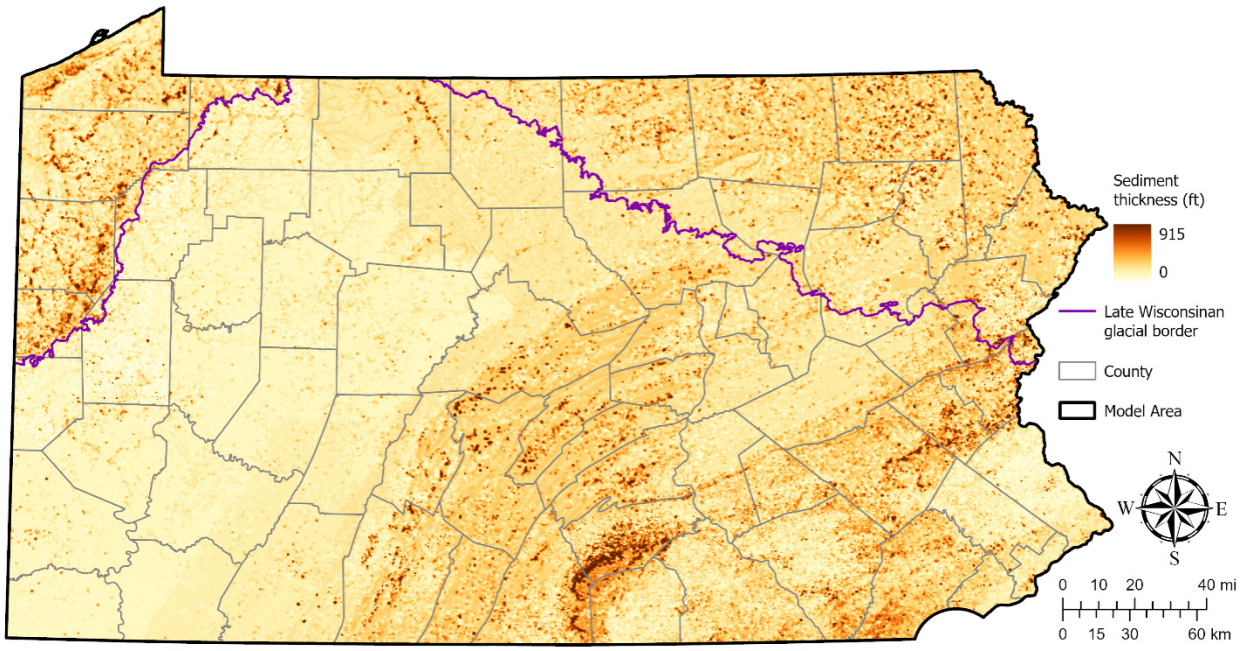

Figure 5. Interpolated sediment thickness based on well data and the surrogate model.

DIGITAL ELEVATION MODEL OF BEDROCK TOPOGRAPHY

The first generation of this bedrock model is accessible through the Pennsylvania Spatial Data Access (PASDA) and PaGEODE. Bedrock elevations represented by raster values are relative to the North American Vertical Datum of 1988 (NAVD88) in feet (Figure 6). Since the bedrock elevation model is derived from statistical computations, the resultant prediction should be presented as a range of values rather than a single, definitive surface. A 90-percent confidence interval has been generated based on comparison of the model prediction and empirical data. The elevation data are presented as a 3-band raster in feet above mean sea level. Each cell contains three values: a predicted bedrock elevation and the upper and lower bounds of the prediction.

Unlike previous drift thickness and bedrock elevation mapping efforts that relied on hand-contouring techniques, the methodology developed through the course of this project is designed to be replicated with minimal manual input. The process can be rerun and a new model can be generated as new data are collected. Thus, the bedrock elevation model can be refined and improved on a periodic basis to reflect the continually expanding well-borehole dataset. In essence, this innovative GIS methodology marks a significant stride toward a comprehensive 3D geologic framework for Pennsylvania. This achievement not only exemplifies the power of modern geospatial techniques but also underscores the bureau's commitment to refining and expanding its geological insights over time.

ACKNOWLEDGMENTS

Funding for this project was provided in part from a 2021 Great Lakes Geologic Mapping Coalition grant, administered through the U.S. Geological Survey. I acknowledge the diligent efforts of Craig Ebersole and Ellen Fehrs in executing this pioneering methodology and producing the bedrock elevation model. The project team extends their gratitude to CivicMapper LLC for their invaluable contributions to the project.

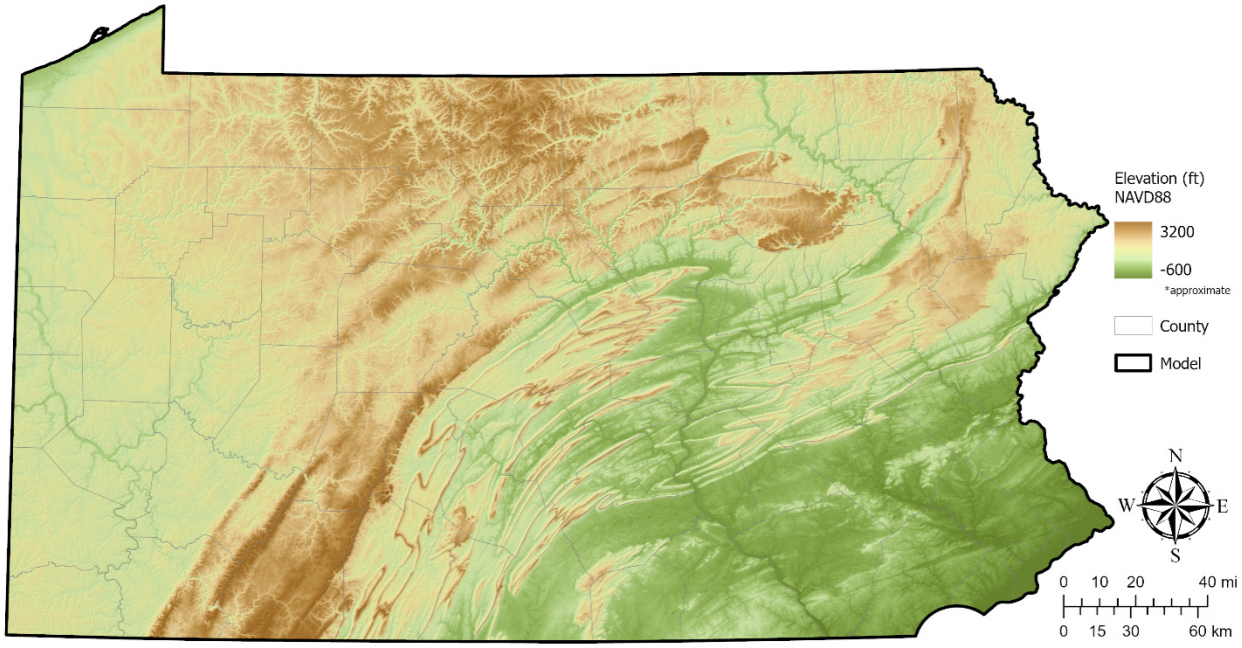

Figure 6. Digital elevation model of bedrock topography beneath unconsolidated sediments of Pennsylvania (Guiseppe and Ebersole, 2023).

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Reese, S. O., Fleeger, G. M., and Schagrin, Z. C., 2022, Bedrock-topography and drift-thickness maps of the Edinburg, Harlansburg, New Castle North, and Slippery Rock 7.5-minute quadrangles, and Pennsylvania part of the Campbell 7.5-minute quadrangle, Butler, Lawrence, and Mercer Counties, Pennsylvania: Pennsylvania Geological Survey, 4th ser., Open-File Report OFSM 22–01.0, 7 p., scale 1:24,000, geodatabase. [Available online at https://maps.dcnr.pa.gov/publications/Default.aspx?id=1001, accessed February 23, 2024.]

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Weiss, A. D., 2001, Topographic position and landforms analysis: San Diego, Calif., Poster presentation, ESRI Users Conference. [Available online at https://www.jennessent.com/downloads/TPI-poster-TNC_18x22.pdf, accessed February 23, 2024.]

ANNOUNCEMENT

87th Field Conference of Pennsylvania Geologists, October 3–5, 2024, Gettysburg, Pennsylvania

Save the date and come join your fellow Pennsylvania geologists for a romp through South Mountain and the many geological and historical features of the Gettysburg area. Keep an eye out for the 2024 conference announcement and registration link to be released **this coming July.** Spaces are limited, and we expect seats to fill up quickly. As your new conference chair, I wish to thank Kristen Hand for her many years of service and dedication to the field conference. I am excited to welcome you to Gettysburg, Pa., and I look forward to seeing you there!

—Ted Tesler

Attendees at the 2008 Field Conference of Pennsylvania Geologists at Gettysburg, Pa. Photograph by Gary Fleeger.

EARTH SCIENCE TEACHERS' CORNER

The Pennsylvania Geological Survey and Its Role in Education, Student Recruitment, Skills Building, and Retention in Geoscience

Adam J. Ianno and Stacey M. Daniels
Pennsylvania Geological Survey

In Pennsylvania, a new set of K–12 educational standards, the Science, Technology and Engineering, Environmental Literacy and Sustainability (STEELS) Standards, was published on July 16, 2022, and designed to be implemented by July 1, 2025. We are excited for efforts like this that will help bolster student recruitment into geology and earth sciences through more exposure to our science. We envision that these standards will greatly increase engagement, knowledge, and understanding of earth and environmental science, and will provide more meaningful outdoor recreation experiences for students in their formative years.

We recognize that developing effective classroom curricula is an iterative process. Likewise, developing earth science programming for outreach and public consumption needs to be carefully geared toward engaging audiences where they are. There are resources available for these efforts, such as materials hosted by the Science Education Resource Center (SERC) at Carleton College, including a large library of activities, exercises, and other materials that may aid and inspire earth science educators at https://serc.carleton.edu/index.html. In support of those in Pennsylvania working on projects such as these, we would like to call attention to an opportunity hosted by SERC this coming summer.

We are calling all Pennsylvania geologists, earth and environmental scientists, students, and K–16 educators! The Earth Educators' Rendezvous (EER) 2024 conference, sponsored by the National Association of Geoscience Teachers and SERC, will be hosted at Temple University in Philadelphia from July 15–19, 2024. This event will bring together earth scientists, teachers, and researchers for talks, posters, discussions, and intensive one-, two-, and three-day topical workshops. The programming is geared toward developing effective instructional strategies, addressing teaching challenges in different educational settings, developing students' competency, supporting lesson and exercise creation, and pursuing new educational research to address our challenges.

The Pennsylvania Geological Survey will be hosting a roundtable discussion at EER about the role that state geological surveys play in recruiting and engaging the next generation of geoscientists. Many residents are not aware of the existence of state geological surveys or of the educational and professional resources that the state surveys provide. Our goal with this roundtable is not only to encourage engagement with the surveys and show options and ideas for working with us outside of traditional internship programs or outreach events, but also for us to hear about what products and ideas geologists and educators would like us to pursue going forward. This conversation will continue our first panel discussion about recruitment and retention of earth science students and how state geological surveys can leverage their talents and expertise toward aiding effective recruitment that took place at the 2024 Northeastern Section meeting of the Geological Society of America in Manchester, N.H., this March.

The Pennsylvania Geological Survey has an extensive collection of scientific publications, geologic map products, Educational Series booklets, and Trail of Geology pamphlets, among many others, available for download at Pennsylvania GEOlogic Data Exploration (PaGEODE) (https://www.gis.dcnr.state.pa.us/pageode/). We appreciate hearing how people use our materials in their classrooms and their suggestions as to how our materials might be even more useful going forward.

Join the conversation! Information about the EER in Philadelphia can be found at https://serc.carleton.edu/earth_rendezvous/2024/index.html. Early registration is open until May 6, and the travel stipend deadline is April 10.

Information about the new STEELS educational standards can be found at https://www.education.pa.gov/Teachers%20-%20Administrators/Curriculum/Science/Pages/Science-Standards.aspx.

RECENT PUBLICATION

Map (January 2024)

- Bedrock-topographic and drift-thickness map of the Bessemer, New Castle South, and Portersville 7.5-minute quadrangles, and the Pennsylvania portion of the New Middletown 7.5-minute quadrangle, Butler and Lawrence Counties, Pennsylvania (ZIP)

From the Stacks . . .

Jody Smale, Librarian
Pennsylvania Geological Survey

The bureau continues to add a diverse selection of publications to its library. Listed below are some recent additions to the library's shelves. With these, both the researcher and the casual reader can visit the sites explored during the 2023 annual meeting of the Geological Society of America in Pittsburgh; learn more about dinosaurs and mining and mineral resources; and continue reading about the struggles of, and the achievements made by, women in the field of geology.

The library is open to the public, and scheduling an appointment before visiting is *strongly encouraged*. A photo ID is required to borrow books; the loan period is four weeks. For more information, or to schedule a visit, please contact the library at RA-pagslibrary@pa.gov or call (717) 702–2020.

- ***Dinosaurs—A concise natural history*** (4th ed.) / David E. Fastovsky and David B. Weishampel, Cambridge University Press, 2021.
- ***Field excursions to the Appalachian Plateaus and the Valley and Ridge for GSA Connects 2023*** / edited by Brett T. McLaurin, Geological Society of America Field Guide 66, 2023.
- ***Mineral exploration and mining essentials*** (revised 5th printing) / Robert Stevens, Pakawau GeoManagement, 2022.
- ***Mineral resources, economics and the environment*** / Stephen Kesler and Adam Simon, Cambridge University Press, 2015.
- ***Mines of the Dillsburg, Pennsylvania area, and other related enterprises*** (2nd ed.) / Robert F. Gayman, Northern York County Historical and Preservation Society, 1998.
- ***Museums at the forefront of the history and philosophy of geology—History made, history in the making*** / edited by Gary D. Rosenberg and Renee M. Clary, Geological Society of America Special Paper 535, 2018.
- ***Plate tectonics—Continental drift and mountain building*** (2nd ed.) / Wolfgang Frisch, Martin Meschede, and Ronald C. Blakey, Springer, 2022.
- ***The geological interpretation of well logs*** (3rd ed.) / Malcolm Rider and Martin Kennedy, Rider-French Consulting Ltd., 2018.
- ***Women and geology—Who are we, where have we come from, and where are we going?*** / edited by Beth A. Johnson, Geological Society of America Memoir 214, 2018.

A Look Back in Time

Anna Jonas Stose (front row, first from the left) is seen here (wearing a tie!) attending the Association of State Geologists field trip in Berlinsville, Northampton County. From 1919 to 1937, Stose served as a geologist with the Maryland and Pennsylvania Geological Surveys. For more information about her and other female geologists who worked in Pennsylvania, see the article on page 3.

Among the state geologists in the photograph is George Ashley (back row, center of the slab of rock), who served as the first director and State Geologist of the Fourth Pennsylvania Geological Survey. This photograph was taken by former bureau geologist Ralph Stone on October 15, 1925.

To see more photographs from the bureau's archives, please visit the library's Historical Photographs Collection page.

—Jody Smale, Librarian

Calling All Authors

Articles pertaining to the geology of Pennsylvania are enthusiastically invited.

Pennsylvania Geology is a journal intended for a wide audience, primarily within Pennsylvania, but including many out-of-state readers interested in Pennsylvania's geology, topography, and associated earth science topics. Authors should keep this type of audience in mind when preparing articles.

Feature Articles: All feature articles should be timely, lively, interesting, and well illustrated. The length of a feature article is ideally 5 to 7 pages, including illustrations. Line drawings should be submitted as jpg files. Ensure that black and white drawings are not saved as color images.

Articles should be submitted as Microsoft Word files. Feature articles will be reviewed by at least one bureau staff member. It is the author's responsibility to obtain approval for use of any illustrations that are copyrighted, including those taken from the Internet.

Earth Science Teachers' Corner: Articles pertaining to available educational materials, classroom exercises, book reviews, and other geologic topics of interest to earth science educators should be 5 pages or less in length and should include illustrations where possible.

Announcements: Announcements of major meetings and conferences pertaining to the geology of Pennsylvania, significant awards received by Pennsylvania geologists, and other pertinent news items may be published in each issue. These announcements should be as brief as possible.

Photographs: Photographs should be submitted as separate files and not embedded in the text of the article. Please ensure that photographs as submitted are less than 10 inches wide in Photoshop or equivalent. Also ensure that black and white photographs are not saved as color images.

Submittal: Authors may send their article and illustrations as email attachments to RA-pageology@pa.gov if the file sizes are less than 20 MB. For larger sizes, please submit the files on a thumb drive to the address given below or share the files through OneDrive. All submittals should include the author's name, mailing address, telephone number, email address, and the date of submittal.

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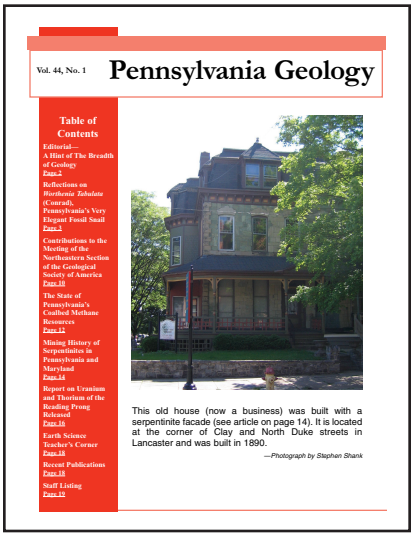
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This old house (now a business) was built with a serpentinite facade (see article on page 14). It is located at the corner of Clay and North Duke streets in Lancaster and was built in 1890.

—Photograph by Stephen Shank

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