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Table of Contents

Sinkholes in the Slab Cabin Run watershed, Centre County, Pa., that caused a pond to drain (David Gold, Emeritus Professor at Penn State, for scale) (see article on page 3).

EDITORIAL

Change During the Pandemic

Gale C. Blackmer, State Geologist
Pennsylvania Geological Survey

Way back when I was teaching at Bloomsburg University, I sometimes used the Northeast Extension of the Pennsylvania Turnpike, now Interstate 476, to travel between Bloomsburg and "home" in Delaware. My favorite part of that trip was the Lehigh tunnel through Kittatinny Mountain. Entering that tunnel was an adventure because coming out the other end was like emerging into a different world. Not only was the geography entirely different, but the weather could go from bright and sunny at one end to gray skies and snow or rain at the other. I feel as though we're in that tunnel now. We can kind of see the other end, but we don't know quite what the world will be like when we emerge. Some things will change, some things will be the same.

At the bureau, one of the most visible changes over the past year is in personnel. Three of our colleagues retired after many decades of dedicated service to the bureau and the commonwealth—Brian Dunst, Lynn Levino, and Mike Moore. Irreplaceable, all of them, although we will do our best to fill the vacancies with others who will become irreplaceable themselves. Combined with a couple of other unexpected departures, we have been pretty short-staffed. But help is on the way. New karst and surficial geologists should be announced in the next magazine issue. Candidate selection is underway for a geochemist. The hiring process is beginning for supervisor of the Subsurface Geology Section in the Geologic Resources Division and for manager of the Geologic and Geographic Information Services Division. If you are interested, feel free to contact me. Both positions should be posted soon on the Pennsylvania Employment website at https://www.employment.pa.gov/Pages/jobopportunities.aspx.

The bureau continues to operate primarily by telework. As of this writing, visitors and volunteers are still not permitted in the offices. Eventually, we will get back to the office, although an element of telework will likely be available to the staff. Our good work continues, too. We are making progress on mapping projects and have started new carbon-storage investigations. Carbon capture and storage is garnering a lot of interest from both federal and state legislatures, so keep an eye out for new developments there. Ellen Fehrs has released elevation-derived hydrography for nine sample HU12 watersheds across the state; data are available from PASDA (Pennsylvania Spatial Data Access). John Neubaum is busy adding important donations of core and cuttings to our collections. Everyone continues to do great work in the face of administrative and logistical challenges. I will say it again—I am so proud of the way the bureau staff has stepped up over the past year to keep our work going and to serve the citizens of Pennsylvania, often in new and innovative ways.

I believe we are headed toward the bright sunny end of the tunnel. Until we emerge, wash your hands, wear a mask, get the shot, and stay safe. We look forward to seeing each other again.

Gale C. Blackmer

The Slab Cabin Run Watershed Study in Pennsylvania, With Applications to Instructional Courses

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INTRODUCTION

Watersheds (also called drainage basins) are fundamental concepts in water-resource management. They represent areas of surface-water and groundwater flow. Within watersheds, conservation districts and environmental groups strive to balance water resources with land development. This is a continuing challenge. Watershed studies assist in this by providing assessments and developing databases for future comparisons.

A watershed study of Slab Cabin Run at State College in Centre County, Pa. (Figures 1, 2, and 3), is described in this paper. Slab Cabin Run is an 11.2-mile-long tributary to Spring Creek (Figures 2 and 3)—a High Quality, Cold Water Fishery (HQ–CWF) commonly rated as the top trout stream in the state (Young, 2018). With an area of 16.8 square miles, Slab Cabin Run watershed represents approximately 19 percent of the surface flow to Spring Creek (Fulton and others, 2005). Because smaller watersheds flow into larger ones, adverse changes in the former can show up in the latter.

This study is an outgrowth of a geology field-mapping course at The Pennsylvania State University. The primary objective was to map local bedrock geology. In conjunction with that activity, a watershed study of Slab Cabin Run was done that included geochemical analyses, flow measurements, and assessments. Those findings are the basis for this article.

While watershed studies are useful in water-resource management, they are also suitable for instructional courses. Concepts such as delineating watershed boundaries, water analyses and flow

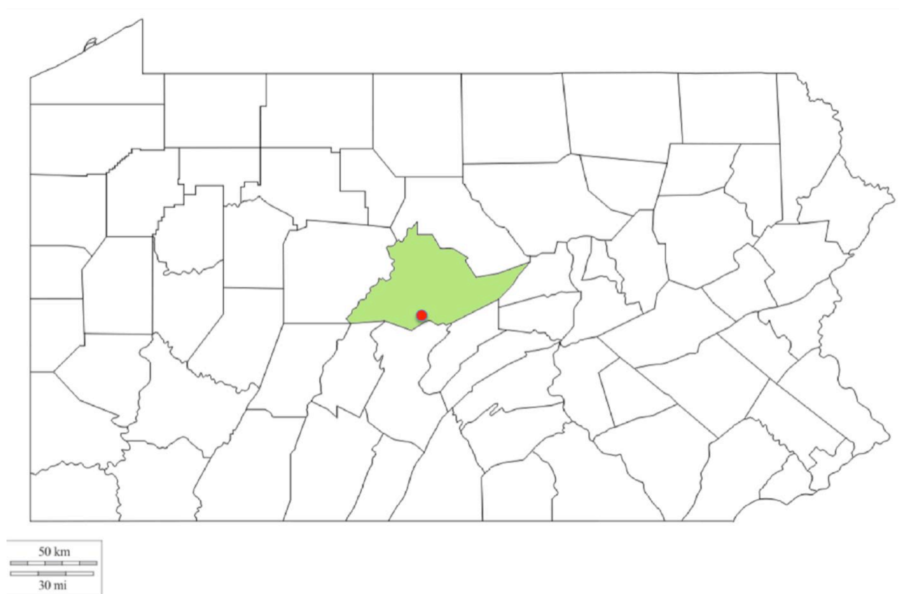

Figure 1. Site map showing State College (red dot) in Centre County, Pa. (from d-maps.com).

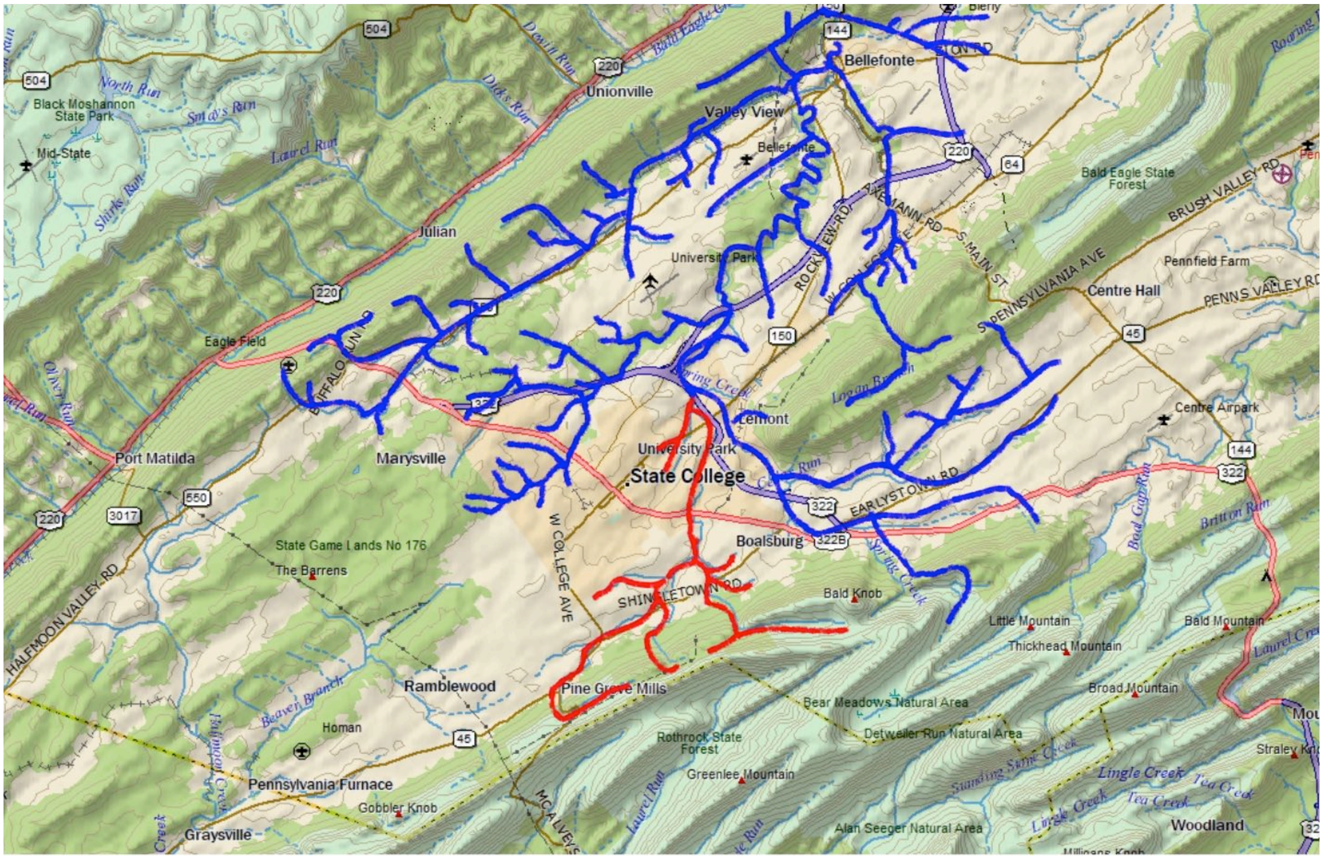

Figure 2. Spring Creek drainage (blue) and the Slab Cabin Run subbasin (red) superimposed on a Google Earth (earth.google.com/web/) base map of the State College, Pa. area.

measurements, aquatic surveys, land-use associations, and data interpretations are adaptable to courses ranging from high school earth science to graduate-level geology.

Applying the Slab Cabin Run watershed study to instructional courses is also considered in this paper. This study uses the best available geological map (Hoskins and Root, 1976) supplemented by an update by Fulton and others (2005) (Figure 3).

GEOLOGIC SETTING

The Slab Cabin Run watershed is at the northwestern edge of the Ridge and Valley physiographic province in Pennsylvania. Ridges are of sandstone and shale, and valleys are largely of carbonates (limestone and dolostone). Major landforms are Mount Nittany, Nittany Valley, and Tussey Mountain (Figure 2). Ridges represent the edges of drainage basins.

The headwaters of Slab Cabin Run are on Tussey Mountain in sandstone and shale of the Juniata and Reedsville Formations (Figures 2 and 3). Downstream flow is across Nittany Valley (Figures 2 and 3), in carbonates (limestone and dolostone) of the Stonehenge, Nittany, and Axemann Formations, to its confluence with Spring Creek (Figures 2 and 3; Table 1).

Carbonate bedrock in Nittany Valley is developed into karst topography. Local karst features include soluble fractured rock at or near the surface; sinkholes (see figure on cover); caves; sinking streams; solutionally enlarged bedding planes, joints, and fractures; and low stream density.

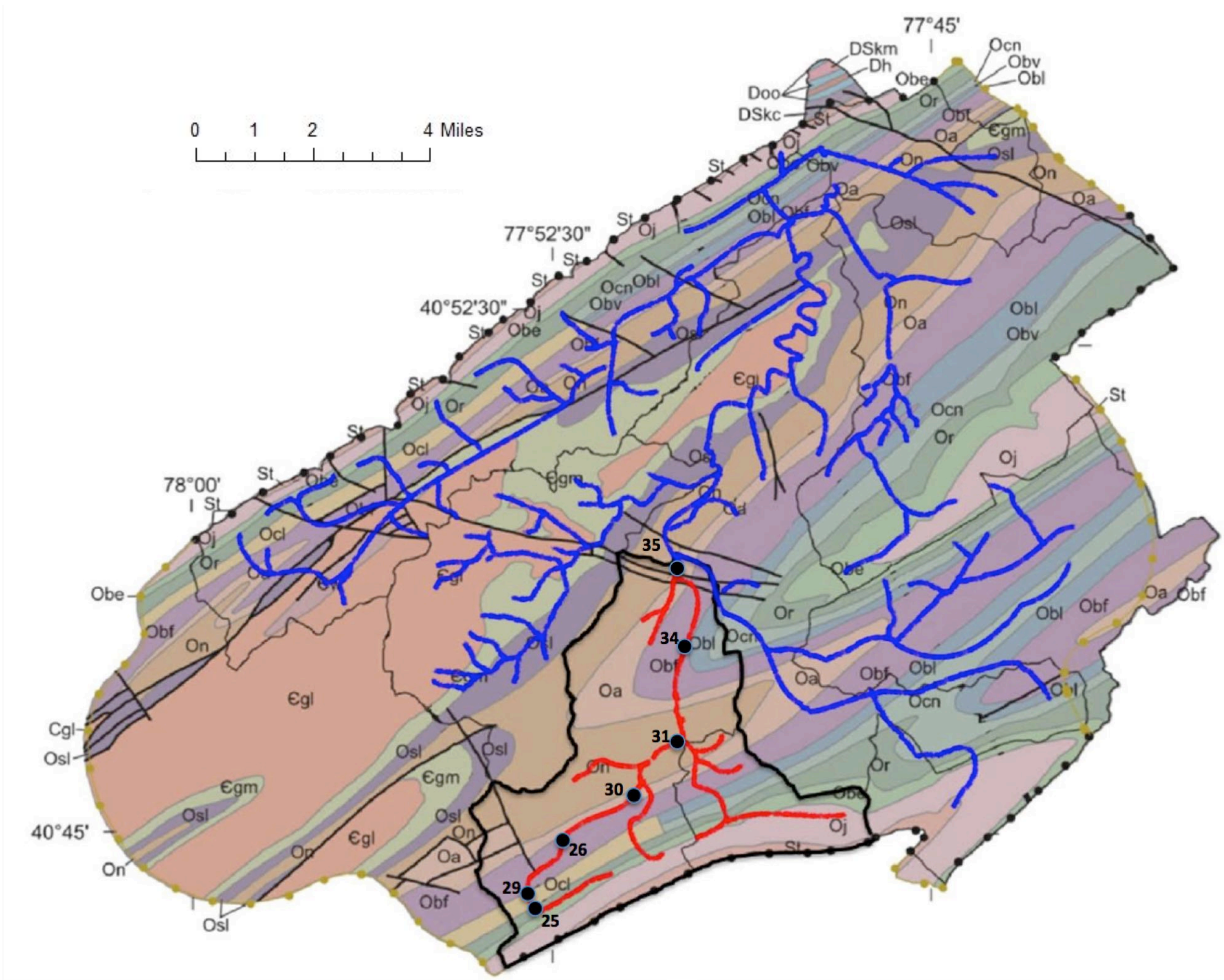

Figure 3. Geologic map showing the Slab Cabin Run watershed (bold black outline). Modified from Fulton and others, 2005. Formation symbols are updated in Table 1; symbols not included in Table 1 are explained in Fulton and others, 2005. Blue lines, Spring Creek watershed; red lines, Slab Cabin Run watershed; black dots, sampled stations.

The study area includes portions of the following Pennsylvania 7.5-minute topographic quadrangles: Julian, McAlevys Fort, Pine Grove Mills, and State College.

THE WATERSHED STUDY—AN OVERVIEW

The Slab Cabin Run watershed study involved stream sampling and flow measurements from its headwaters to its confluence with Spring Creek. A bedrock geology base map (Figure 3) shows the watershed and stream-sampling points. The map is supplemented by stratigraphic information for the watershed (Table 1). Using the map and table together, relationships between bedrock geology, water quality and quantity, and land uses can be noted.

A sampling sequence of stations 25, 29, 26, 30, 31, 34, and 35 (Figure 3; Table 2) began in the headwaters and continued downstream to Spring Creek. Sampling stations 32 and 33 are of a tributary to Slab Cabin Run and are not addressed. Water-data analyses and flow measurements are presented in Table 2.

Table 1. Stratigraphic Information for Slab Cabin Run Watershed
(Map symbols are shown on Figure 3)

Formation name	Map symbol	Lithology
Juniata	Oj	siltstone/shale/sandstone
Reedsville	Or	shale
Coburn, Salona, Nealmont, Linden Hall Snyder, Loysburg	Ocl	limestone with shale, limestone
Bellefonte	Obf	dolostone
Axemann	Oa	limestone
Nittany	On	dolostone
Stonehenge	Osl	limestone

Water-quality parameters included the following: pH, alkalinity, hardness, calcium and magnesium concentrations, calcium/magnesium ratio, and nitrate. Concentrations are in parts per million (ppm). Flow measurements are in cubic feet per second (cfs) (Table 2). Water analyses were done using Lamotte water-sampling kits. Flow measurements were from a Pygmy Flow Meter.

WATER DATA

Water-quality and flow data of Slab Cabin Run, from its headwaters to its mouth, are best observed by comparing Figure 3 with Tables 1 and 2. From these, a number of observations can be made.

Table 2. Geochemical Analyses and Flow Measurements for Slab Cabin Run
(Map symbols are shown on Figure 3; data from 1975)

Station number	Map symbol	pH	Alkalinity (ppm)[1]	Hardness (ppm)[1]	Calcium (ppm)[1]	Magnesium (ppm)[1]	Ca/Mg ratio	Nitrate (ppm)[1]	Flow (cfs)[2]
25	Or	5.6	20	50	25	25	1:1	<0.44	1.58
29	Ocl	6.8	90	125	75	50	1.5:1	<.44	NM[3]
26	Obf	7.3	80	130	60	70	0.86:1	2.64	.16
30	Oa	7.3	110	180	100	80	1.25:1	1.32	.27
31	On	7.0	170	200	125	75	1.67:1	>1.32, <2.64	.25
34	Obf	7.1	170	187	87	100	0.9:1	>1.32, <2.64	.54
35	Oa	7.1	180	275	130	145	3:1	>1.32, <2.64	1.95

[1] ppm, parts per million
[2] cfs, cubic feet per second
[3] NM, not measured

The Slab Cabin Run chemistry reflects the bedrock over which it flows. This is evident when considering pH, as well as alkalinity, hardness, and calcium and magnesium concentrations, in addition to calcium/magnesium ratios (Table 2). The latter three are among the most useful parameters for obtaining water-quality information characterizing carbonates (Langmuir and White, 1971). Although the source of Slab Cabin Run is in the Juniata Formation (Oj on Figure 3), the first sampling station is in the Reedsville Formation (Station 25 on Figure 3; Tables 1 and 2). The Reedsville has little buffering capacity. However, pH levels, as well as alkalinity, hardness, and calcium and magnesium concentrations, markedly increase as the stream crosses carbonates (Stations 29, 26, 30, 31, 34, and 35 on Figure 3). For example, pH rises from 5.6 in the Reedsville to 6.8 and 7.3 in carbonates (Osc and Olt on Figure 3; Table 2). Similar increases occur for the other referenced parameters. One parameter—hardness—is noteworthy. Hardness is a measure of dissolved minerals in water, mostly of calcium and magnesium (Bates and Jackson, 1980, p. 284). Nittany Valley is known for hard water, largely due to the high solubility of carbonates. Comparison of Slab Cabin hardness concentrations in the Reedsville (Station 29 on Figure 3; Table 2) to the contact with carbonates (Station 26 on Figure 3; Table 2) shows a marked increase from 50 to 125 ppm. That concentration increases to 275 ppm at Station 35 (Figure 3; Table 2) farther downstream.

Nittany Valley carbonates consist of limestone and dolostone. The former is calcium carbonate ($CaCO_3$) and the latter is calcium magnesium carbonate ($CaMgCO_3$). Elevated magnesium concentrations (Table 2) are largely associated with dolostone exposures, specifically the Nittany and Bellefonte Formations (On and Obf, respectively, on Table 2). The high magnesium concentration at Station 35 appears, at first, as anomalous, since it is associated with predominantly limestone strata of the Axemann Formation (Oa on Table 2). However, the Axemann contains alternating dolostone and limestone strata. In addition, this station is the most downstream sampling point along Slab Cabin Run. Therefore, it collectively reflects the sum of dissolved minerals for the watershed.

Of the water-quality parameters in this study, nitrates (Table 2) best reflect land-use impacts. Nitrate concentrations in Slab Cabin Run headwaters are virtually nil. However, concentrations increase significantly for sampling points in Nittany Valley (29, 26, 30, 31, 34, and 35 on Figure 3; Table 2). Primary sources of elevated nitrates in this watershed are manure, chemical fertilizers, and onsite septic systems. The first two are mostly associated with agricultural practices. Chemical fertilizers, however, can also originate from other land uses such as golf courses and residential lawns.

Slab Cabin Run flow is related to lithology (Figure 3; Tables 1 and 2). Typically, flow increases with stream length. This is because more drainage area contributes recharge as downstream distance increases. However, this is not always true for Slab Cabin Run. Flow in its headwaters (Figure 3) (Station 25 on Table 2) is 1.58 cfs. Upon contacting carbonate strata (Obf on Table 2), there is a marked decrease in flow to 0.16 cfs (Station 26). This represents a 90 percent flow reduction from Station 25 to 26. Reduced flow continues downstream until Station 35, where it increases to 1.95 cfs. Streams can have gaining and losing segments. The referenced section of Slab Cabin Run with flow loss is a "losing stream." Surface water is lost to carbonates that have high transmissivity due to their soluble nature. Water is lost via swallow holes (sinkholes in stream channels) and fractures enlarged through solution. At Station 35, there is sufficient inflow into Slab Cabin Run to more than compensate for loss to underlying carbonates. The gaining and losing characterization of stream segments is not necessarily a permanent one. It is contingent upon precipitation. During high precipitation periods, all of Slab Cabin Run may be a gaining stream.

LAND USES

One application of watershed studies is identification of land uses and their potential impacts. Virtually all land use (referring to human use) within a watershed has potential impact on receiving streams. Slab Cabin Run watershed is no exception. This watershed is 37 percent agriculture, 35 percent forest, and 27 percent residential (Osmond and others, 2012). Land-use impacts in this watershed are considered next.

Agriculture is a major source of total suspended solids (TSS) and nitrates. Elevated TSS concentrations largely result from livestock grazing along stream banks and land disturbances associated with crop planting. High TSS concentrations can impact aquatic ecosystems. Brown trout, as in Slab Cabin Run and Spring Creek, require clean, coarse gravel for reproduction (Carline and others, 2004). Primary agricultural sources for elevated nitrates were discussed under "Water Data." Nitrates can indirectly affect trout because nitrogen is a nutrient for aquatic plants, causing them to proliferate. When this happens, dissolved oxygen concentrations can decline, affecting trout and other aquatic fauna. Because flow from Slab Cabin Run eventually goes to the Chesapeake Bay, nitrate levels are of concern due to their impact on the Bay's ecosystem.

Forest growth is probably the most stabilizing land use in the watershed. However, tree removal for roads and developments increases runoff, decreases groundwater recharge, and increases TSS. One consequence of increased runoff and decreased recharge is more rapid and more frequent flash flooding.

Residential land use is another name for urbanization—that is, making an area more urban. Urbanization creates a litany of watershed impacts. Waterproofing land surfaces with impervious materials for roofs, sidewalks, roads, and parking lots leads to reduced infiltration and increased flash flooding, increased total suspended solids, chemical residues, and increased surface-runoff temperatures detrimental to trout. Construction projects can increase TSS concentrations. Schueler (1994) found that stream biodiversity declined when impervious surfaces exceeded 10 percent. Wang and others (2003) found that trout were largely eliminated when the connected imperviousness exceeded 10 percent of the watershed. These examples suggest that there may be an upper limit to which watershed land surfaces are waterproofed before trout are unsustainable.

Sedimentation and pollution are the two major sources of impairment to Slab Cabin Run (Spring Creek Watershed Commission, 2020). As discussed, both can be linked to the three referenced land uses: agriculture, forest, and residential.

IMPLICATIONS OF A KARST SETTING

Soluble carbonates present potential hydrogeologic issues as Slab Cabin Run flows across Nittany Valley. Much groundwater in local carbonates travels via solution channels, ranging up to the size of large caves. An out-of-area example is shown in Figure 4. This is known as conduit flow. The channels act as underground pipes capable of conveying large volumes of water rapidly over great distances. Similarly, they can just as easily transfer other fluids such as gasoline.

In the Slab Cabin Run watershed are storage tanks, some for gasoline. According to Baniewicz, (2010), Pennsylvania has had 14,766 releases from storage tanks since regulations were passed in 1989. A large majority of the tanks stored gasoline. Lost gasoline can infiltrate to the water table, degrade water quality, and yield explosive vapors. Within the watershed, at least one underground storage tank in Nittany Valley is known to have leaked (Yoxtheimer, 2015).

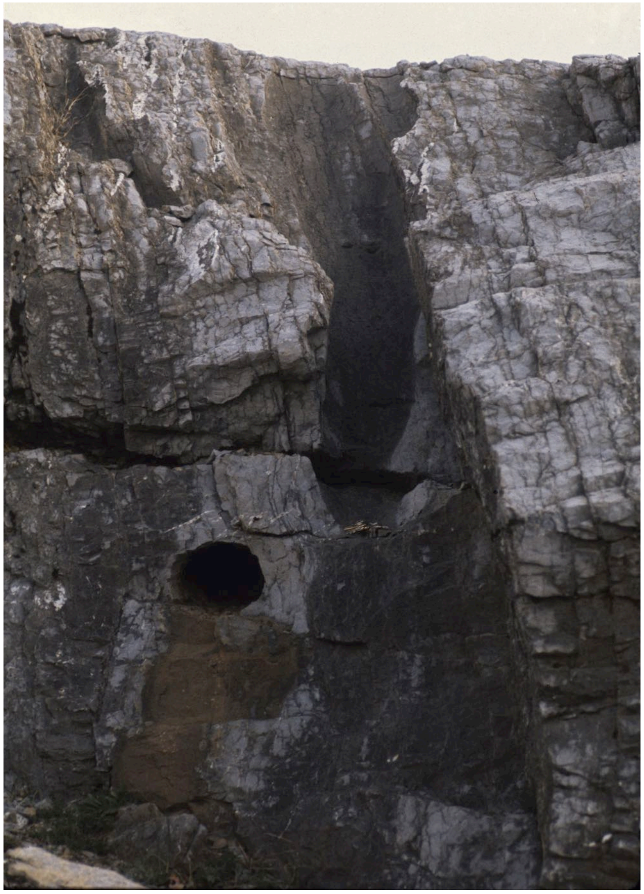

Figure 4. Solution channels in limestone at Pinesburg, Md. Photograph taken on April 11, 1976.

Two examples of gasoline leaking in Pennsylvania's karst settings are described next, as they demonstrate what could happen in Nittany Valley. From 1969 to 1970, 216,000 gallons of gasoline were pumped from wells at Mechanicsburg (Rhindress, 1971). In 1970, an underground gasoline storage tank at Spring Mills leaked 200 to 250 gallons of gasoline into limestone. Fuel migrated to a water well, causing an explosion that created a crater 25 feet in diameter and 12 feet deep (Figure 5) (Gold and others, 1970).

Closer to the Slab Cabin Run watershed is Thornton Spring in State College, near Lemont. Recharge to this spring is also in carbonates. Thornton Spring has the distinction of being a Superfund site in State College. It became a classic example of groundwater contamination in karst when 29 chemicals, including Kepone and Mirex, were detected (U.S. Environmental Protection Agency, 2004).

WATERSHED PROTECTION

Slab Cabin Run watershed is a valuable resource. It contributes surface flow to Spring Creek, a premier trout stream, and to Chesapeake Bay, a protected estuary. In addition, the watershed is a groundwater recharge area in Nittany Valley. This is particularly important because all of Penn State's drinking water at University Park, and most of State College's, is groundwater. Several ways to protect the watershed are presented below, some of which have been implemented.

Giddings (2016) described several protective measures that relate to the Slab Cabin Run watershed. A 2010 local ordinance requires grouting boreholes, such as for drilled wells and vertical heat pumps. This requirement replaces an old practice using finely crushed limestone to backfill boreholes. Crushed limestone is very permeable, and its use, as described, allows surface water and/or contaminants to flow into groundwater aquifers. The ordinance increases groundwater-quality protection in the watershed. Another watershed water-resource protection measure is the use of storm-water detention basins. These enhance groundwater recharge, control total suspended solids, and reduce flash flooding. Their efficacy is increased if lateral or serpentine flow paths are incorporated in the basins. Within the watershed, another ordinance establishes surface-water protection areas of Tussey Mountain. This involves setback distances for seeps, springs, and streams. Water from Tussey Mountain represents much of the groundwater recharge for Nittany Valley (Konikow, 1971). Implementation of this ordinance enhances groundwater quality and quantity.

Farm animals grazing along the banks of Slab Cabin Run can be a major source of total suspended solids. One way to reduce this is by creating riparian (vegetated) zones along the stream. Vegetation

Figure 5. Ejecta material in the crater resulting from a well-water explosion in limestone at Spring Mills, Pa. Photograph by Richard R. Parizek (1970). Used with permission.

retards overland surface flow, causing suspended sediment to be contained prior to reaching the stream. Carline and others (2004) described these efforts for Slab Cabin Run. When done in conjunction with other stream-bank improvements, there are reductions in TSS, and increased macroinvertebrate densities are noted.

ADAPTING THE WATERSHED STUDY TO INSTRUCTIONAL COURSES

The Slab Cabin Run watershed study is adaptable to a variety of earth science, environmental science, and geology classes ranging from high school to graduate level. Most of its component parts can be applied to these courses, contingent upon student academic background. These include water-data interpretations with reference to geology and land use.

Of any watershed study, the most basic component is the watershed, that is, its areal extent. Topographic maps are requisite for delineating the boundaries. Whereas a watershed includes both surface and groundwater flow, delineation largely reflects the former. There are situations, however, where watershed boundaries of associated groundwater and surface flow may not coincide, as in the Spring Creek watershed (Figure 3). Difference in areal extent of the two related watersheds is largely due to a combination of structural control and topographic slope. Groundwater delineation uses observations from groundwater instruments such as piezometers and from point-source flows such as springs and seeps.

The Slab Cabin watershed study combines geology, chemistry, and land uses. This interdisciplinary approach can be expanded to include biology when incorporating electroshocking (Figure 6) and other aquatic assays. In Pennsylvania, these surveys are generally under the auspices of the Pennsylvania Fish

Figure 6. Action image of Pennsylvania Fish and Boat Commission personnel electroshocking a stream in Clinton County in 1987.

and Boat Commission. In electroshocking, electricity from portable generators stuns fish. After being identified, weighed, and measured, fish are released. Aquatic surveys can also include benthic larvae that are food for fish. These surveys assist in assessing a stream segment's health and are used in determining whether certain land uses impact a receiving stream. For example, pre-mining stream surveys provide a base for comparison during or after potential polluting activities. The surveys complement water analyses of the same stream segments. Introducing biology into a watershed study complements geology, chemistry, and land-use considerations.

CONCLUSION

Slab Cabin Run is a major tributary to Spring Creek, one of the best trout streams in the state. The watershed transitions from headwaters in siliciclastic rocks on Tussey Mountain to karst topography in Nittany Valley. Relationships between bedrock geology, water chemistry, stream-flow characteristics, and land-use effects are evident. Karst topography in the watershed creates hydrogeologic scenarios conducive to groundwater pollution. Some watershed land-use issues have implications as far away as the Chesapeake Bay.

It is likely that the watershed will continue to be challenged from land-use impacts as the State College area grows. Each change has the potential to impact the watershed relative to water quantity and quality, both in regard to Slab Cabin Run and to groundwater recharge for State College. As a result, growth should be in concert with watershed protection measures.

This watershed study has applications in a wide variety of instructional courses, ranging from high school to graduate level. The study is interdisciplinary by incorporating geology, chemistry, and geography (land use). It can be extended to include biology in the form of aquatic stream surveys.

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Roger J. Cuffey, Emeritus Professor of Paleontology, David P. Gold, Emeritus Professor of Geosciences, and Roy Greenfield, Emeritus Professor of Geophysics, all of The Pennsylvania State University, are acknowledged for their editing, assistance, and useful discussions. Any errors are those of the author.

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EARTH SCIENCE TEACHERS' CORNER

A Mini-Podcast Series Highlighting Global-Warming Solutions in Pennsylvania

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In the summer of 2019, The Pennsylvania State University (Penn State) partnered with the nonprofit organization Project Drawdown (https://www.drawdown.org/) to offer the Drawdown Scholars Research Experience for Undergraduates (REU) program. More than 50 undergraduate students from across the United States came to Pennsylvania to work on research and curriculum development around the theme of "drawdown," the point at which concentrations of greenhouse gases in the atmosphere begin to decline, ultimately reversing global warming. Among the diverse REU projects presented by the students, one of them focused on climate-solution efforts taking place in the state of Pennsylvania to create an informative mini-podcast collection appropriate for educators to use in middle school through university classrooms.

An audio collection was selected as the final product, as data from multiple recent polls show that there is an increase in the number of individuals engaging with stories and interviews via audio (e.g., Shearer, 2019), including a projected increase of podcast use in higher education (Spinelle, 2019). However, there still remains a lack of earth science podcasts, with MacKenzie (2019) documenting that only about 4 percent of all science-themed podcasts focus on climate science. The recently produced podcasts for the "Drawing Down in Pennsylvania" collection help address the gap in content but also focus on efforts in Pennsylvania, making the content locally relevant to residents.

The foundation of the audio collection consists of the eight podcasts, which are focused on addressing each sector of global-warming solutions modeled by Project Drawdown (Hawken, 2017)—buildings and cities, electricity generation, food, land use, materials and waste, ocean, transportation, and women and girls. To highlight efforts in Pennsylvania, 13 interviews were conducted with scientists, journalists, and professionals from organizations across Pennsylvania, such as Feeding Pennsylvania, Southeastern Pennsylvania Transportation Authority, Philadelphia Green Roofs, StateImpact Pennsylvania, and Land Air Water Legal Solutions (a full episode listing of who was interviewed is shown in Table 1). The collection starts with an introductory episode, then includes the episodes covering the eight topics, and wraps up with two additional episodes—one titled "Hope" that has messages of optimism from all the interviewees toward achieving global-warming solutions, and a special episode that focuses on Penn State and its connection to drawdown. In total, the 11 episodes provide 155 minutes (approximately 2.5 hours) of audio listening.

The website that shares the podcasts is divided into separate pages based upon the Project Drawdown sectors. Each page contains links to supplemental materials (websites and videos). All pages have scripts generated for each audio file. The scripts make the podcasts ADA (Americans with Disabilities Act) accessible to anyone with auditory issues. In addition, by providing the scripts, we have enabled students to print out these files and to follow the text as the audio files are played, which helps develop student listening and reading skills.

Table 1. "Drawing Down in Pennsylvania"—Podcast Playlist and Interviews

Episode	Length (minutes)	Interviewees featured
Introduction to "Drawing Down in Pennsylvania"	18:51	• Dr. Tom Richard, Director, Penn State Institutes of Energy and the Environment; Professor of Agricultural and Biological Engineering • Dr. Katharine Wilkinson, Vice President at Project Drawdown, senior writer of the book *Drawdown*
Buildings and Cities	18:46	• Mr. Kiere DeGrandchamp, High Performance Homes • Ms. Jeanne Weber, Founder/Owner/Principal of Philadelphia Green Roofs LLC
Electricity Generation	17:29	• Mark Hammond, Environmental Attorney, Land Air Water Legal Solutions LLC • Marie Cusick, reporter, StateImpact Pennsylvania • Dr. Tom Richard, Director, Penn State Institutes of Energy and the Environment; Professor of Agricultural and Biological Engineering
Food	18:55	• Jane Clements-Smith, Executive Director, Feeding Pennsylvania • Nadia Sheppard, Intern at the Rodale Institute
Land Use	17:53	• Dr. Armen Kemanian, Associate Professor of Production Systems and Modeling in the Department of Plant Science, Penn State University • Dr. Tom Richard, Director, Penn State Institutes of Energy and the Environment; Professor of Agricultural and Biological Engineering
Materials and Waste	7:30	• Mark Hammond, Environmental Attorney, Land Air Water Legal Solutions LLC
Ocean	13:25	• Dr. Adrienne Oakley, Associate Professor of Geology and Marine Science, Kutztown University • Caroline Ladlow, University of Massachusetts Amherst (M.S. degree in Geosciences)
Transportation	11:42	• Rebecca Collins, Corporate Initiative Manager for Sustainability, Southeastern Pennsylvania Transportation Authority (SEPTA) • Marie Cusick, reporter, StateImpact Pennsylvania
Women and Girls	11:32	• Dr. Katharine Wilkinson, Vice President at Project Drawdown, senior writer of the book *Drawdown* • Dr. Verónica Montecinos, Professor of Sociology, Penn State Greater Allegheny
Hope	8:43	• Nine interviewees from other episodes
Penn State and the Drawdown Connection	10:26	• Dr. Tom Richard, Director, Penn State Institutes of Energy and the Environment; Professor of Agricultural and Biological Engineering

All materials are available online at https://sites.psu.edu/drawingdownpa/. In addition, the audio-only files can be found at https://soundcloud.com/drawingdownpa.

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BOOK REVIEW

A Dictionary of the Fossils of Pennsylvania and Neighboring States Named in the Reports and Catalogues of the Survey, by J. P. Lesley

A Dictionary of the Fossils of Pennsylvania and Neighboring States Named in the Reports and Catalogues of the Survey, by J. P. Lesley, Second Geological Survey of Pennsylvania, Report P4, v. 1, p. v–xiv, Letter of Transmittal, p. 1–437 plus text figures, 31 p. of errata; v. 2, p. 439–914 plus text figures, 10 p. of errata; and v. 3, p. 915–1283 plus text figures, 13 p. of errata, 1889.

In *A Dictionary of the Fossils of Pennsylvania and Neighboring States named in the Reports and Catalogues of the Survey* (herein referred to as the *Dictionary*), published by the Second Geological Survey of Pennsylvania, State Geologist J. Peter Lesley (1819–1903) provided a thorough listing of the fossil taxa then known from the Keystone State and surrounding region. This octavo three-volume dictionary-format tome on fossils is profusely illustrated and contains more than 3,000 figures, mostly copied from the well-known works of numerous noted paleontologists including E. D. Cope, T. A. Conrad, E. Emmons, J. Hall, E. Hitchcock, J. M. Leidy, L. Lesquereux, F. B. Meek, J. S. Newberry, C. D. Walcott, K. A. von Zittel, and others. In his Letter of Transmittal (v. 1, p. v–xiv), Lesley stated two main purposes for the *Dictionary.* First, it was to provide an illustrated alphabetical compendium of all fossils cited in the numerous reports of the Survey so that these descriptions did not have to be repeated multiple times in detail in the numerous other reports. The second purpose was to make available to the citizens of Pennsylvania the often out-of-print scientifically published illustrations or original drawings of the type specimens of the rich fossil faunas of the commonwealth that might not otherwise be accessible to them.

The *Dictionary* is one of numerous reports generated by the Second Geological Survey of Pennsylvania (conducted from 1874–89), which was known in its era for the extraordinary number and quality of geological reports it published. The Pennsylvania Geology Collections webpage (https://digital.libraries.psu.edu, accessed January 2021) of The Pennsylvania State University Libraries indicates that "… over 80 texts, nearly 600 accompanying maps and illustrations, a hand atlas, a six-volume grand atlas, and miscellaneous other publications …" were produced by the Second Geological Survey of Pennsylvania, creating a "… treasure trove of geologic, economic and historic information about Pennsylvania during the Golden Age." According to Jon Inners, former chief of the Geological Mapping Division of the Pennsylvania Geological Survey, the reports and geological maps generated during the time of the Second Geological Survey of Pennsylvania continue to be relevant and serve as valuable references for the current mission and deliverables of the Fourth Survey (Jon Inners, personal communication, January 2021).

The *Dictionary* includes and illustrates the broad range of fossil forms, including those from plants, animals, and trace fossils, known at the time to be from Pennsylvania and the surrounding region (but additionally from elsewhere if an association with Pennsylvania and its geology existed or could exist). Although not the primary intent of this compendium, a few new species are also briefly described and illustrated. Volume 1 (A–M) begins with the arthropod *Acantherpestes major* and ends with the bivalve (pelecypod) *Mytilus edulis.* Volume 2 (N–R) begins with the bivalve (pelecypod) *Naiadites* and ends with the trilobite-associated ichnotaxon *Rusophycus bilobatus.* Volume 3 (S–Z) begins with the crinoid *Saccocrinus christyi* and ends with the brachiopod *Zygospira modesta.* While the taxonomy and nomenclature of some of the listed forms may have since been revised, the *Dictionary* provides a very nicely illustrated and well-referenced compilation.

Prior to the *Dictionary* being published, J. Peter Lesley was living in Philadelphia and was a Professor of Geology and Mining at the University of Pennsylvania (1859–83); he also served as the secretary and librarian of the American Philosophical Society and was one of the charter members of the National Academy of Sciences. He was appointed State Geologist and Director of the Second Geological Survey of Pennsylvania in 1874. Interestingly, he was also ordained as a Presbyterian minister, but later became Unitarian. Like many geologists and paleontologists of his time, Lesley apparently struggled to reconcile evolution by natural selection with the religious and scientific dogma of the late 19th century. While he may have initially supported the concept of Darwinian evolution, by 1880 he had become openly critical in some of his letters and writings (Goldfine, Howard, 2009, “Darwinism comes to Penn,” *The Pennsylvania Gazette,* v. 108, no. 2, p. 38–43). In his Letter of Transmittal for the *Dictionary,* Lesley repeatedly mentioned the stratigraphic importance of fossils for Pennsylvania’s coal and mining industries, but he also clearly reflected his skepticism over evolution when he stated (v. 1, p. v), “Those who please to speculate on the evolution of life, may amuse themselves with traces of resemblance, but they cannot find a single proof, however slight, for the actual hereditary descent of the living creatures of our age from those of preceding ages.”

Despite sometimes outdated taxonomy and nomenclature, the *Dictionary* still has broad appeal due to its historical nature, comprehensive (for its time) coverage, and copious illustrations. Original copies of this 1889 publication can be found at old- and rare-book dealers, and even sometimes on eBay™. A modern facsimile reprint of the entire dictionary is available through Book Depository (www.bookdepository.com) or other similar reprint services. This publication can also be viewed online compliments of several digital collections, including those of the State Library of Pennsylvania (https://statelibrary.pa.gov) and the Pennsylvania Geology Collections webpage of The Pennsylvania State University Libraries (https://digital.libraries.psu.edu).

—Albert J. Robb, III
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FROM THE STACKS . . .

The Library's Historical Photographs Collection Page Has a New Look!

Jody Smale, Librarian
Pennsylvania Geological Survey

Since 2015, the bureau has shared its collection of historical photographs online through POWER Library, Pennsylvania's Electronic Library, which is funded by the Office of Commonwealth Libraries of Pennsylvania, Pennsylvania Department of Education. Recently, there has been a change in the software used to upload and share these photographs. ***Islandora*** is an open-source software digital repository system, and it is the new system being used to upload and share these digital images (Figure 1). With Islandora, you can continue to search, view, and download photographs from the bureau's collection. Currently, there are more than 4,600 photographs available on the Islandora site (https://digitalarchives.powerlibrary.org/papd/islandora/object/papd%3Aspgsl-photo); however, we continue to scan and upload photographs. Because of this, if the collection is accessed through the new link, even more images from the bureau's collection will be available. Please note that the previous version of the collection is still available online, but no new photographs are being added to that site, and the site will be taken down effective May 30, 2021.

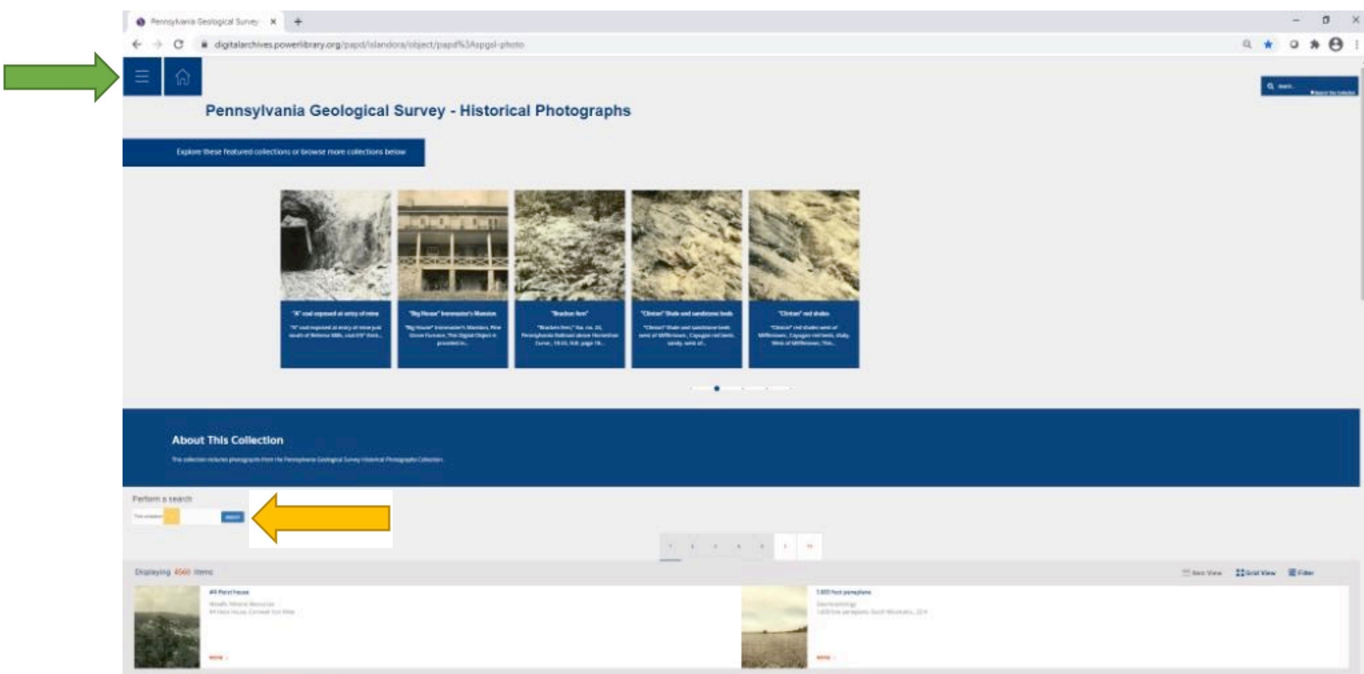

Figure 1. The new website for the bureau's Historical Photographs collection. Here you can search the collection (see the search box to the left of the yellow arrow), or you can perform an Advanced Search by clicking on the Menu button in the upper left-hand corner of the screen (indicated by the green arrow) and narrow your results by Title, Subject, Location, and so forth. You can also browse through the collection page by page to see all the photographs in the collection.

The Historical Photographs collection includes photographs taken by bureau geologists and staff members dating as far back as the 1920s and covers a wide range of topics, including geologic features, cities and towns, and the state's quarrying, mining, and oil and gas industries. You are encouraged to browse the collection and take a look back to see how Pennsylvania's landscape has changed over the years, and also to see some of the quarries, mines, and oil wells that helped to shape Pennsylvania's economy in the 20th century.

BUREAU NEWS

A Look Back in Time

Former State Geologist (from 1919 to 1946) George Ashley took this photograph in September of 1941, showing the view southeast from Bald Eagle Mountain. A truck can be seen on an unidentified road on what appears to be a beautiful fall day in Centre County. Tussey Mountain is in the distance.

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 1 to 2 pages 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@state.pa.us if the file sizes are less than 6 MB. For larger sizes, please submit the files on CD–ROM to the address given below. All submittals should include the author's name, mailing address, telephone number, email address, and the date of submittal.

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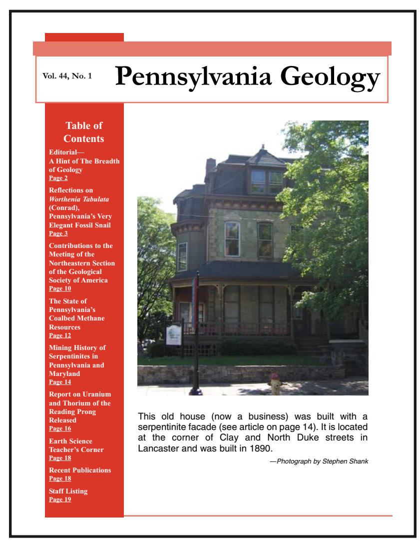
Vol. 44, No. 1 Pennsylvania Geology

Table of Contents

Editorial—
A Hint of The Breadth of Geology
Page 2

Reflections on *Worthenia Tabulata* (Conrad), Pennsylvania's Very Elegant Fossil Snail
Page 3

Contributions to the Meeting of the Northeastern Section of the Geological Society of America
Page 10

The State of Pennsylvania's Coalbed Methane Resources
Page 12

Mining History of Serpentinites in Pennsylvania and Maryland
Page 14

Report on Uranium and Thorium of the Reading Prong Released
Page 16

Earth Science Teacher's Corner
Page 18

Recent Publications
Page 18

Staff Listing
Page 19

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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