Rusting oil-storage tanks such as these occur in the woods near Gringo, Hopewell Township, Beaver County. They are a testament to the once great Shannopin oil field (see article on page 3).
EDITORIAL

Carbon
Gale C. Blackmer, State Geologist
Pennsylvania Geological Survey

Americans have a complicated relationship with carbon. Let me use myself as an illustration. I like the trappings of modern civilization: climate-controlled buildings, hot showers, driving wherever I want to go, my cozy new fleece jacket, and lots of handy plastic things. All of these derive in one way or another from hydrocarbons, which must be extracted, transported, processed, and used, with environmental side effects at each step. I also try to tread lightly on the planet, doing my best to conserve, recycle, and generally consume less. How does one live both comfortably and responsibly? It’s a conundrum.

Pennsylvania also has a complicated relationship with carbon. Coal put Pennsylvania on the map, fueling its economy and great industries for more than two centuries. The oil industry started here, and, of course, we have abundant natural gas. Extraction and use of these resources continue to be a large part of the commonwealth’s economic base. At the same time, Pennsylvania is home to an abundance of beautiful natural lands. The state constitution recognizes the right of citizens to clean air and clean water. When President Trump pulled the United States out of the Paris Climate Accord, Pittsburgh—arguably the city that carbon built—stuck to its goals to combat climate change. In January, Governor Wolf signed an executive order establishing the first statewide goal to reduce carbon emissions in Pennsylvania. It’s quite the balancing act.

The Pennsylvania Geological Survey navigates all this by operating the same way we have always done—providing quality scientific data and information to everyone who needs it. The information we provide on subsurface geologic structure, stratigraphy, and the reservoir characteristics of rock layers is equally as useful for extracting carbon in the form of oil and gas as it is for capturing and storing carbon back underground. Our staff moves easily between our colleagues in the extractive industries and in the environmental realm. After all, no matter which part of the carbon cycle you occupy, a good scientific basis can only make your processes more efficient and responsible. Science can help us keep our balance.

Gale C. Blackmer
INTRODUCTION

During World War II, my grandfather purchased a bankrupt farm at a sheriff’s sale that straddled the boundary between northwestern Findlay Township, Allegheny County, and southeastern Independence Township, Beaver County (Figure 1), apparently because he wanted his grandchildren to experience a rural setting at some point in their formative years. I spent most of my summers from the mid-1950s until 1968 at “Harpers Achers,” as Grandpa dubbed it, at first helping to grow and harvest corn, potatoes, and other vegetables, as well as fruit from the orchard. A few years after Grandpa died, “Harper’s Achers” became more of a summer vacation home, where my brothers and I played baseball, swam in our 55°F swimming pool, mowed what seemed like hundreds of acres of yard, climbed trees (and broke bones falling out of them), skinned our knees, contracted poison ivy, and took pot shots with a .22-caliber rifle at some unassuming tin cans and glass jars. With lots of forests, fields, creeks, and a nearby golf course to play in, we would explore the woods or hike the local country roads. We often headed down to Raredon Run, a creek that ran through the valley on the west side of “Harper’s Achers,” sometimes with our artist father in tow (or vice versa). While Dad photographed or painted scenes such as the “Old Iron Bridge” (Figure 2), we boys built sandstone dams, harassed the crayfish and minnows living there, and admired the splendor of the Jerusalem artichoke, Oswego tea, Joe-Pye weed, and cardinal lobelia growing in profusion along the stream banks.

On these latter trips, my brothers and I occasionally stumbled upon old oil-field equipment—rusting pipes, snarled drilling cables, crumbling bull wheels, and dilapidated engine houses. When the family went grocery shopping in adjacent Beaver County, we typically traveled a route that took us past a rusting pipe derrick standing on a nearby hill. At the time, I was too young to recognize the significance of these items; they were just old junk we passed along the way. While playing in Raredon Run, we would encounter rainbow oil slicks on the water from leaking pipelines on the creek bank. My older brothers, who spent more time on the farm in the early days than I did, remember hearing the sounds of engine barkers\(^1\) chuffing away in the valley on a quiet evening. I have no memory of that—the barkers were all silent and the wells abandoned by the time I began spending more time at “Harper’s Achers.”

After I joined the Pennsylvania Geological Survey in the late 1970s, I discovered that all of the old equipment, the oil slicks, and the engine barkers were part and parcel of one of the most important oil fields in southwestern Pennsylvania, the Shannopin oil field (Figure 3).

OIL IN BEAVER COUNTY? REALLY?

Beaver County doesn’t readily come to mind when one thinks about the history of oil and gas exploration and production in Pennsylvania, especially when we have such world-renowned oil regions

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\(^1\) A barker is steel pipe attached at an angle at the end of the oil-well engine’s exhaust pipe that generates a unique sound. It allowed the well operator to tell from a distance whether the engine was running or not.
as Venango and McKean Counties in the northwestern part of the state. The Drake Well, Oil Creek, the giant Bradford oil field—those are historically important places. But Beaver County? Incredible as it might seem, Beaver County had, and continues to have, an important place in the annals of petroleum history.

Beaver County’s first oil well was drilled 180 feet into one of the Pottsville Formation sandstones (Pennsylvanian) just north of the Ohio River, not far from the Pennsylvania/Ohio/West Virginia border. It was begun in 1859 after word of Drake’s well reached the county, and it was completed in 1860 (Bausman, 1904; Lytle, 1950; Armler, 1976). The discovery of oil in Beaver County led to “black gold fever,” causing many more wells to be drilled nearby and, eventually, elsewhere. By the early 1900s, 25 oil and gas fields and pools had been discovered in the county. As with other areas of the world, activity surged and ebbed with various “boom” and “bust” cycles, but Beaver County’s oil industry never
BEAVER COUNTY IS A GAS, MAN

In the early days, many people believed that oil could be found in Beaver County south of the Ohio River, but since most of the oil fields were situated north of the river, very few were willing to get involved in risky wildcat operations. Eventually, in 1884, a group of investors staked a claim outside the village of New Sheffield (now part of the town of Aliquippa) (Figure 1) and began drilling. Instead of oil, however, they got a large flow of natural gas under high pressure. Discovery of the New Sheffield gas field generated its own “fever” by spurring other companies to drill in parts of the county that had not been explored previously. This brought so much prosperity to the area south of Aliquippa that many of the farmers abandoned farming altogether in pursuit of working in the more profitable gas industry. The first commercial gas company to operate in the area, the Bridgewater Gas Company, transported natural gas to towns along the Beaver and Ohio Rivers and even as far away as East Liverpool and Wellsvile, Ohio, and New Cumberland, W. Va. Bridgewater eventually became part of Manufacturers Light and Heat Company, which is now part of the Columbia Gas system (Woolsey, 1906; Waples, 2005).

Throughout the late 1800s, the New Sheffield field grew to be the largest gas field in Beaver County. Experts considered the quality of the gas to be excellent, although near the southeastern edge of the field it tended to be somewhat oily. By 1886, however, there had been so much drilling and consumption that the gas pressure in the field decreased substantially, forcing the operators to abandon many of the wells.

OIL COMES TO SHANNOPIN

At some time around 1885, a pair of experienced Pennsylvania drillers decided to drill a well between Shannopin in Hopewell Township, Beaver County, and nearby Shousetown in Crescent
Township, Allegheny County (now called South Heights and Glenwillard, respectively) (Figure 1). Production from that well was not particularly large, but it did establish that oil occurred in the area, and soon the rush began. Both villages produced oil (Boyle, 1898), but Shannopin loaned its name to the entire oil field.

A majority of the drilling and production in the Shannopin field actually occurred 2.5 miles west of Shannopin in the area around, and southwest of, the village of Gringo (Figure 1). Early Gringo wells (see photograph on page 17) flowed 100 to 400 barrels of oil per day (BOPD), with some producing more than 1,000 BOPD. According to Lytle (1950), one well began producing at 400 BOPD before rapidly increasing to between 3,000 and 3,800 BOPD, holding the record as the largest oil well in the field. By October 1886, the Shannopin field was producing 5,000 BOPD from only 29 wells (Boyle, 1898), the kind of news that quickly dominated industry scuttlebutt in the county. Numerous oil companies sprang up, including the Raccoon Oil Company and the Shannopin Oil Company, and established companies such as the Galey Brothers and the Westinghouse Company were drilling wells in the new field. During Shannopin’s peak period, the Raccoon Oil Company produced approximately 2,000 BOPD (Smith, 2014). A few years later, Forest Oil Company, a subsidiary of John D. Rockefeller’s Standard Oil Company, acquired Raccoon.

TO BE OR NOT TO BE SHANNOPIN

Although the field was named for Shannopin, most of the wells, and the best production, occurred between Gringo and Bocktown several miles southwest of Shannopin (Figures 1 and 3). Considering Gringo’s importance to the industry, it was a wonder they didn’t give a separate name to the Gringo-Bocktown area. Gringo became a boomtown almost overnight, and Bocktown flourished briefly as an oil storage and transportation hub. Shannopin, originally called Ethel’s Landing, flourished mostly
because of its location on both the Ohio River and the Pittsburgh and Lake Erie Railroad. This made it an ideal oil storage and transportation terminal. In the late 1870s, the railroad erected a station named Shannopin for an Indian tribe that had resided in the area. The residents of Ethel’s Landing, apparently more impressed with the name Shannopin, renamed the village. Shannopin eventually became incorporated as the Borough of South Heights in 1909 because another community near Pittsburgh, also named Shannopin, had precedence, and the U.S. Postal Service was delivering Shannopin’s mail there instead (Beaver County Historical Research and Landmarks Foundation, 2018). Today, South Heights (Shannopin) is a borough along the Ohio River, Gringo is an unincorporated village in Hopewell Township, and Bocktown is a small grouping of rural homes at a minor road intersection in Independence Township (Figure 1). Even Shousetown, the Allegheny County portion of the Shannopin field, was renamed Glenwillard.

As a matter of convenience, I am calling the small oil pool near South Heights “Shannopin pool” and the much larger pool to the southwest “Gringo pool” (Figure 3). Neither name has any official status.

THE RISE AND FALL OF A GREAT OIL FIELD

The rock pressure in the Shannopin field began to decline as early as 1889, and wells in the southern part of the “Gringo pool” began to be invaded by water encroaching on the reservoir from downdip (southeast). Operators began repressuring the reservoir with natural gas in the pool in 1913, tripling production in some wells (Lytle, 1950), but the entire field continued to decline. Although an estimated 500 wells had been drilled in the Shannopin field since its discovery, around the beginning of World War II only about 35 wells were still in production (Lytle, 1950). By the 1990s, the last operator in the field, C. C. Wharton, produced oil from only eight wells located in Gringo. At his gas-compressor station at the Pa. Route 151 intersection of the Beaver Valley Expressway (now Interstate Route 376, or I–376), the donkey engine he used to repressure his wells blew perfect concentric smoke rings from the exhaust stack, much to the amusement and amazement of passing drivers. Wharton acquired the rights to the oil in Gringo from the South Penn Oil Company in 1949 when there were still 21 producing wells. Over the years, 10 of the wells went dry, and three were taken through eminent domain and plugged when I–376 was built (Collins, 1983). When Mr. Wharton died in 1995, the field officially became abandoned, relegating Gringo to a mere “bedroom community” with little memory of its once great oil history. All that remains of the Shannopin field are rusting pipelines and storage tanks (see cover), and the demolished remains of Wharton’s compressor station (Figure 4).

GEOLOGY OF THE SHANNOPIN SAND

Operators in both the Shannopin and New Sheffield fields called the primary reservoir rock, which averaged about 1,600 feet below the surface, the “Shannopin sand”2 (Figure 5). This reservoir was merely a thin, distal extension of the Hundred-Foot sand, the uppermost unit of the Upper Devonian Venango Formation3 in southwestern Pennsylvania. The Hundred-Foot, a persistent zone of sandstone and shale layers that commonly has an average thickness of 100 feet, correlates with the Venango First sand of Venango County (Harper and Laughrey, 1987). Historically, it has been a prolific oil and gas reservoir from Butler County south to West Virginia. A thick layer of shale and siltstone commonly divides the Hundred-Foot into two distinct sandstone layers, the upper, thinner Gantz sand and the

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2 The Gordon and Fourth sands of the Venango Formation also produced some oil and gas in the two fields, but they were more important in the Allegheny County portion of the “Shannopin pool.”

3 Some geologists consider the Venango in this part of the state to have group status, following the terminology presented in the “Stratigraphic Correlation Chart of Pennsylvania” (Pennsylvania Geological Survey, Report G 75, 1983).
lower, commonly much thicker, Fifty-Foot sand (Figure 6). As with most formations in western Pennsylvania, the Hundred-Foot sand becomes progressively thinner westward until only about 10 to 30 feet of sandstone exists as a tongue of the lower Fifty-Foot sand. This is the Shannopin sand. Stratigraphically, it is actually a thin sandstone bed within the upper portion of the Upper Devonian Ohio Shale (Figure 6).

The Shannopin sand varies from fine-grained sandstone to conglomerate and averages about 30 feet thick (Lytle, 1950). In the “Gringo pool,” it has a hard, siliceous caprock a few inches thick overlying a coarse-grained to conglomeratic sandstone containing many pebbles up to one inch in the longest dimension. This sandstone is where the pay zone occurred (Woolsey, 1905; Lytle, 1950). In the “Shannopin pool,” the sand had two pay zones, one about five feet into the sand and the second about 15 feet below the first (Lytle, 1950).

Based on Wagner and others (1975) and Dodge (1985), the regional geologic structure dips to the southeast (Figure 6); the reservoir in the “Gringo pool” typically lies between 500 and 700 feet below sea level, whereas in the New Sheffield field it is only 350 to 450 feet below sea level. In other words, the Shannopin sand in the New Sheffield field is at a higher elevation than in the Shannopin field. As mentioned previously, when operators drilled in the southeastern part of New Sheffield adjacent to Shannopin, they found that the gas tended to be oily. It seems obvious that the reservoir sandstone’s porosity and permeability were great enough, even in the non-productive area between the two fields, for some Shannopin oil to travel updip and invade the lower gas-producing portion of New Sheffield. Thus, increased gas production in the New Sheffield field most likely decreased the native gas pressure in the Shannopin field, thereby decreasing the flow of oil throughout the 1800s until necessary
repressuring by gas injection began in the early 1900s. Overdrilling and overproduction undoubtedly caused a rapid decline in both fields. Then, to add insult to injury, updip water (brine) migration from the southeast began to “water out” the reservoir in the Shannopin field.

WHO SAYS THERE’S NO MORE OIL LEFT?

Lytle (1950) estimated the original reserves in the Shannopin field at 7.9 million barrels of in-place oil in an area of only 3,900 acres, an average of 2,000 barrels per acre. That means that Shannopin had the third highest oil reserves in all of southwestern Pennsylvania. Only the very large Washington-Taylorstown field in Washington County and the even larger McDonald field in Allegheny and Washington Counties had higher reserves in southwestern Pennsylvania (both fields also have much larger acreages than Shannopin). Lytle (1950) estimated that 2.2 million barrels probably were recoverable from the field by a combination of primary (flowing and pumping) and secondary (gas repressuring) methods, leaving 5.7 million barrels in the reservoir for any future tertiary recovery methods. Interestingly, Carll (1887) had reported that 483,338 barrels had been produced (by flowing and pumping alone) in 1887, a number more than twice the amount Lytle (1950) considered to be recoverable by primary methods 63 years later, indicating that Lytle’s numbers were on the low side. The implications of this are interesting. Since the Shannopin field was almost completely abandoned by the time Lytle gathered his data (during World War II), and the only enhanced recovery used in the field was gas repressuring (a simple secondary method), a huge amount of oil must still remain in the field that should be recoverable by improved technological methods.

GONE, BUT NOT FORGOTTEN (?)

Today, the Shannopin field is gone and all but completely forgotten by the residents of southwestern Pennsylvania. The large flowing wells in the “Gringo pool” and the oil transportation and storage stations at South Heights and Bocktown disappeared well before the mid 1900s. Little remains of this once-prolific oil field other than rusting storage tanks and pipes that still can be seen along creeksides
and roads (Figure 4), and the memories of some of the older folks in the area. Despite large remaining estimated reserves of crude oil, the Shannopin field most likely will remain abandoned forever. Unless, that is, and until some enterprising company with plenty of megabucks decides to go to all the trouble of acquiring leases, locating all the old wells, plugging or replugging them, and then reestablishing oil-field operations using the latest technology for coaxing water-saturated crude oil out of the ground. I certainly don’t expect that to happen anytime soon.

REFERENCES


INTRODUCTION. An intrusion of interns; that’s what we called ourselves.

A few weeks into the summer of 2018, we interns from the Pittsburgh office of the Pennsylvania Geological Survey (Figure 1) decided that we needed a group name. We arrived at the word intrusion; the alliteration was perfect, but the metaphor even more so. An intrusion is defined as molten rock (magma) that invades country rock. We loved it and have used the term ever since.

OUR TASKS. There was never a shortage of work to be done at our new jobs. A variety of tasks needed to be completed, and, as a result, so did our duties over the course of the summer. The projects revolved around the Midwest Regional Carbon Sequestration Partnership (MRCSP), through which most of our internships were funded. The MRCSP is a public and private consortium assessing the technical potential, economic viability, and public acceptability of carbon sequestration within ten contiguous states: Indiana, Kentucky, Maryland, Michigan, Ohio, Pennsylvania, West Virginia, Delaware, New Jersey, and New York. The MRCSP project is nearing completion of Phase III, an expansion of the characterization of regional reservoirs and seals performed during Phases I and II.

GEOPHYSICAL LOGS GALORE! The first few weeks were dominated by sorting through a generous donation of geophysical logs from a local energy company (Figure 2). Our goal was to look for and sort out logs in relatively good condition, but there were a lot more than just standard geophysical logs in the lot. We found tiny logs just inches in size, compact discs, various unrelated personal notes, cuttings from wells, and strange pictures from drill sites. It took a few weeks, but we eventually sorted through the whole donation.

Once the logs were sorted, we proceeded to identify the logs in EDWIN, the Exploration and Development Well Information Network, and label the logs with the appropriate API (American Petroleum Institute) well numbers. This could be a bit trickier than it sounded—occasionally the wells were missing permit numbers, and we had to scour through EDWIN to find matching documents, including completion reports or location plats, for the correct API numbers. The logs that weren’t already in EDWIN were handed off to Kim and Jake to scan. Together they scanned more than 6,000 logs.
OTHER TASKS. A variety of other tasks were completed for the MRCSP. Garrett, Jake, Lauren, and Nico learned how to use and digitize logs in Petra®, geologic interpretation software. Jake and Nico worked on various projects in GIS (Geographic Information Systems), and in doing so, they found the number of legacy oil and gas wells in Pennsylvania, West Virginia, and Ohio for select fields. Lauren worked on writing a case-study report for a potential enhanced oil recovery field based on research she had performed for the Department of Conservation and Natural Resources (DCNR) during the previous semester.

We didn’t just learn hard skills—our soft skills developed as we learned how to network, talk, email, and work together in a professional environment. Working at the Bureau also allowed us to meet many great professionals within the industry. Their experience ranged from working in the Bureau for decades, to working for oil and gas companies and environmental consulting firms. Meeting all of these individuals helped us to better understand what fields we might want to go into in the future. We appreciated that staff members were willing to spend time with us, give invaluable career advice, and answer our multitude of questions.

INTERN TRADITIONS. We also engaged in more creative endeavors: the two annual intern traditions. The first was designing a geology-themed display case, and the second was hosting a lunch for the full-time staff. This year our theme for the display case was National Parks. Kim designed a beautiful and colorful poster template, and each of us researched and wrote a short essay on individual parks, highlighting the geological features within them. We also created a diorama at the bottom of the display case that transitioned from a mountain to a beach environment, complete with a river, delta, and even a subsurface cross section. For the lunch, we made a festive geology-themed summertime spread (Figure 3).

ADDITIONAL ACTIVITIES. We took a few field trips as well. Early in the summer, the interns and staff traveled to Economy Park in Beaver County. We helped three students from Baden Academy Charter School look for evidence of old silver mines in the park. According to local legend, silver was mined in the early 1800s by the residents of the area, the Economites. Unfortunately, we found no evidence of silver mines in or around the park. We did learn that certain grounds of the park were part of an open clay mine. The clay gathered from this mine was eventually used in the paving bricks of Old Economy Village in Ambridge.

We drove to Harrisburg one day in June to meet other Bureau interns and full-time staff. Additionally, we sorted through well cores and cuttings at Raccoon Creek State Park. We also had two caving excursions with Pittsburgh staff. We went spelunking through Bear Cave near Blairsville, Pa., and surveyed Harlansburg Cave near Slippery Rock, Pa.
The intern intrusion was a unique blend of skills and personalities, and, as the months went by, the reasons why we were chosen became apparent. Some of us were organized and leadership focused. Others brought creativity and curiosity into the group. Some used their GIS skills from college coursework, and most of us used our geologic knowledge to perform our daily tasks and duties. Each of us provided something different, something valuable as individuals that made this intrusion distinct.

Looking back at this summer, our self-given name of “The Intrusion of Interns” suited our group in ways we couldn’t have realized at the time. In a standard intrusive igneous scenario, magma rises up from a heat source. The magma ascends, absorbing country rock and travelling through preexisting faults or fractures. The magma chamber stalls, cools, and changes. The surrounding country rock in contact with the magma changes as well. As the temperature drops, minerals crystallize in the chamber, forming new rocks. And maybe in the future, the country rock will have eroded away, exposing the intrusion that was once a hot magma chamber.

This past summer, we migrated from our colleges to this Pennsylvania Geological Survey office. Our composition, unique in its blend of personality and experience, ascended up into the country rock of the DCNR. There we stayed for three months, gaining new experiences, knowledge, and tackling challenges. Our composition changed as a result, as did that of the staff who came into close contact with us. Now that the internship has ended, the magma chamber has started cooling. That’s where the intrusion is right now. What minerals will crystallize? What rocks will form? How has this summer at the Bureau changed each of us?

These rocks may not be exposed for a while. We know they are down there though, crystallizing and cooling. More than anything, however, we know that this experience has better prepared us for the future, whether that be in the field of geology or elsewhere.
Staff Changes

In addition to the retirements of Gary Fleeger in March and Tom Whitfied in April, and the addition of Craig Ebersole in June, as announced in the Summer 2018 issue of Pennsylvania Geology, other staff changes have been made recently. In July, Kristen Hand was promoted to supervisor of the Stratigraphic Studies Section of the Bureau. Elizabeth Lyon retired in August and Bill Kochanov retired in December. We welcomed Audrey Kissinger in December and Zachary Schagrin in January of 2019.

AUDREY KISSINGER. Audrey began her career with the commonwealth in August 2011, downstairs from the Bureau in the Snowmobile/ATV Section. In 2012, she transferred to the DMVA (Department of Military and Veterans Affairs) at Fort Indiantown Gap, working in Human Resources. In September, 2015, she left DMVA and once again came to work for the Department of Conservation and Natural Resources as an administrative assistant at Nolde Forest in Reading. Prior to coming to work for the commonwealth, she worked as a civil clerk for a District Judge in Lebanon County. She was born and raised in Lebanon County and continues to live in South Lebanon Township with her husband and their two Westies (West Highland White Terriers), Buddy and Molly. In their free time, they enjoy flipping/remodeling houses (they are on their third one), walking, and spending time with family.
ZACHARY C. SCHAGRIN. A Bucks County native, Zack Schagrin joined the Bureau’s Geologic Mapping Division in January 2019. Zack completed his undergraduate studies at West Chester University of Pennsylvania in 2013, earning a B.A. in political science-public policy and a minor in geology. Looking for an excuse to keep hunting for trilobites, Zack stayed on at West Chester and graduated with a Master’s degree in geology in 2015. Following graduation, he accepted a position at the New Jersey Geological and Water Survey. There, he had the opportunity to learn from the staff as he worked primarily on surficial geologic mapping of the New Jersey Coastal Plain. Zack enjoys working on policy issues in the sciences as well. While he was a graduate student, he completed an internship with the American Geosciences Institute in Washington, D.C., and got to spend time around the Capitol attending hearings related to geoscience topics. He is still looking for ways to combine his political science and geology backgrounds. In his free time, he enjoys following the news, riding his bike, watching just about any sport, and visiting historic sites with his wife, Danielle.
A Look Back in Time

An old oil well in the “Gringo pool,” Beaver County, Pa., still being pumped when this photograph was taken on June 9, 1925. Photograph taken by former Survey geologist, Meredith E. Johnson. See related article on page 3.

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

RECENT PUBLICATION

Open-File Oil and Gas Report (December 2018)

- Pictorial Mud Log and Geological Investigation of Middle Devonian Through Middle Ordovician Formations from the Harry Dewey #1 Pilot Well in Tioga County, Pennsylvania
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.

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**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.

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