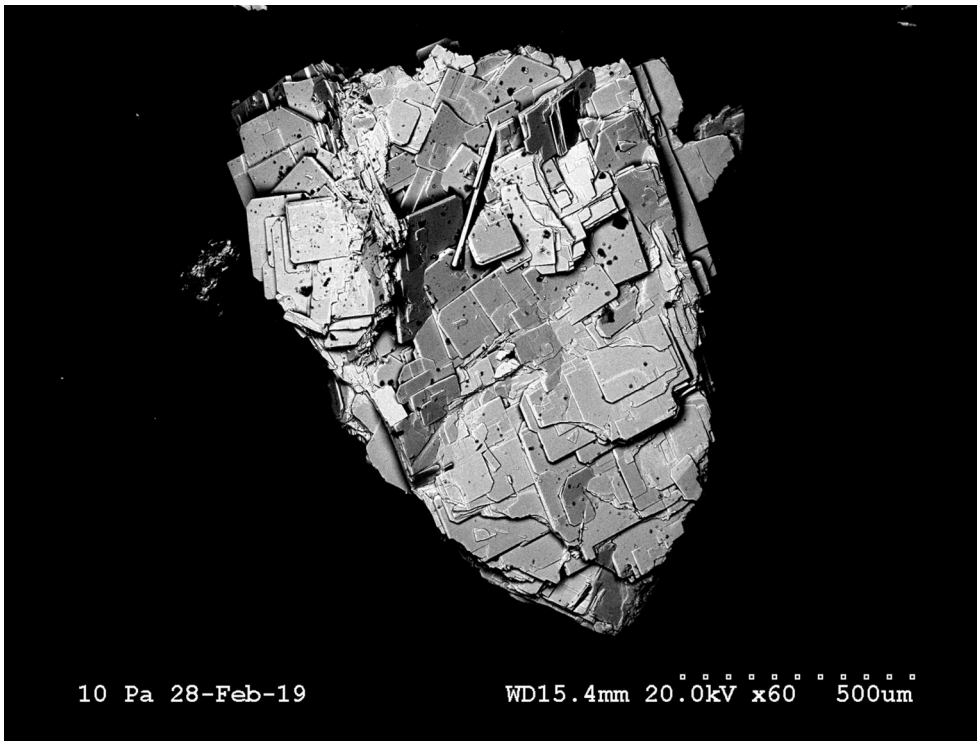
Vol. 51, No. 3

# Pennsylvania Geology

## Table of Contents






High-resolution scanning electron microscope photomicrograph of the larger crystal of lanthanite-(Nd) in a specimen from Friedensville, Lehigh County, Pa., provided by M. L. Anné (see article on page 3).

EDITORIAL

# You Need Minerals!

Gale C. Blackmer, State Geologist
Pennsylvania Geological Survey


The articles in this issue put me in mind of a bumper sticker that my predecessor, George Love, left in the director's office: "If it can't be grown, it has to be mined." That is true of everything from iron to paint pigments to the calcium carbonate in Tums to the lithium in batteries. Without mining, I would not have been able to write this column and you would not have a device to use to read it. Take a moment to look around you—if whatever you see isn't a plant, it was somehow extracted from the earth.

I think we tend to lose sight of just how important earth materials are to our daily lives. The Minerals Education Coalition (www.MineralsEducationCoalition.org) has calculated that every year, 40,633 pounds of new minerals must be provided for every person in the United States to make the things we use daily. Almost half of that is stone, sand and gravel, and cement. The constituent having the smallest amount, according to the Coalition, is manganese, five pounds (per person) of which goes into the making of almost all steel that is used for construction, machinery, and transportation. Some of the minerals in the second half of the list are identified as critical minerals—metals and nonmetals considered vital for the economic well-being of the world's major and emerging economies, yet whose supply may be at risk due to geological scarcity, geopolitical issues, trade policy, or other factors.

Critical minerals research and exploration is one issue that has caught the attention of both sides of our divided political system. That is because they are equally critical to national security, our manufacturing future, and climate change mitigation. Here at the Pennsylvania Geological Survey, we are working on critical minerals projects funded by the U.S. Geological Suvey and by the U.S. Department of Energy (DOE). Some of the DOE research money is going toward development of technologies to extract critical minerals from acid mine drainage and mine waste, both coal waste and hard-rock waste. Those processes would have the double benefit of providing valuable resources while remediating environmental hazards.

Still, most of that 40,633 pounds of new minerals that you personally need every year will have to be taken out of the ground. We all want the benefit of those new minerals, but many of us don't want the quarry or mine in our community. Is it fair to push production into someone else's backyard? Can we maintain national security when the sources are in foreign countries that aren't our friends? Like everything else related to our environment and lifestyle, it's a balancing act.

No answers here. Just food for thought.

Gale C. Blackmer

# The Checkered Past of Lanthanite-(Nd) from Friedensville, Lehigh County, Pennsylvania

## Some Rare-Earth Minerals in Pennsylvania, no. 2[1]

Robert C. Smith, II, and John H. Barnes
Pennsylvania Geological Survey, retired

### THE NOMENCLATURE OF LANTHANITE-(Nd)

Lanthanite-(Nd) is one of Pennsylvania's more oxymoronic minerals because, as Raymond W. Grant correctly reported in Montgomery (1969, p. 67), the predominant lanthanide element in it is neodymium (Nd), not lanthanum (La). It seems as if it should have the mineral species name "neodymite-(Nd)," but that would be a redundant tautology, not to mention that this would not be following the established rules of the International Mineralogical Association's Commission on New Minerals, Nomenclature and Classification. The name "lanthanite-(Nd)" is appropriate because many properties of lanthanite are not noticeably changed when neodymium is the predominant rare earth rather than lanthanum. Part of the nomenclature problem is that neodymium had not yet been recognized as a separate element when lanthanite was first described.

### WHO DISCOVERED LANTHANITE-(Nd)?

A second curious aspect of the checkered past of lanthanite-(Nd) from Pennsylvania, as noted by Arthur Montgomery (1969, p. 65–68), is whether it was found by Dr. W. W. *Dickenson,* Superintendent of the Friedensville mines in 1853, as reported by Blake (1853), or by Dr. Montroville M. *Dickeson,* as reported by Friedrich August Ludwig Karl Wilhelm Genth in 1857, or by a Mr. *Dickson,* who is reported to have sold a single lanthanite specimen to Clarence Bement for $80 in 1867 (as reported by Montgomery, 1969, p. 68) (equivalent to about $1,500 in 2020). Blake (1853) reported that the specimen was thrown out from a shallow exploration shaft in the Friedensville zinc mining district, Lehigh County. Presumably this meant that a miner did not separate it from other overburden that he had dug and discarded. Fortunately, Blake (1853) included sketches of the crystals (Figure 1) in his report. Figure 2, from Smith (1977, fig. 53, p. 146–147, courtesy of A. V. Heyl), is a map of the area of the early exploration shafts at Friedensville made during the era in which the lanthanite-(Nd) was apparently recovered.

More certain is that a Montroville Dickeson was involved in lead mining at New Galena in Bucks County. Figure 3, from Smith (1977, p. 240), is an attempt to summarize surveying that the senior author and his wife had done at New Galena shortly before the lead-zinc (Pb-Zn) veins, mines, mine dumps, and prospects were flooded for a public water-supply reservoir (Smith, 2018). Smith also attempted to summarize the available

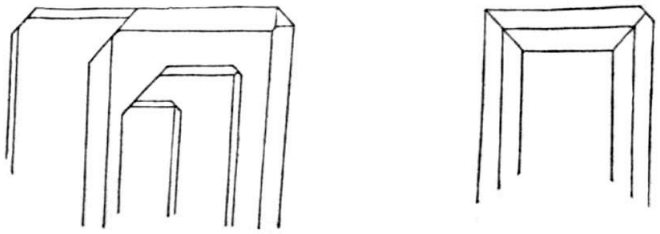


*Figure 1. Sketches of crystals of lanthanite-(Nd) from Friedensville, Lehigh County, Pa. (from Blake, 1853, p. 228).*

[1]For "A Saga Concerning the Identification of Chevkinite-(Ce), a Rare-Earth Titanosilicate from Northampton County, Pennsylvania—Some Rare-Earth Minerals in Pennsylvania, no. 1," see *Pennsylvania Geology,* v. 49, no. 1, p. 3–11.

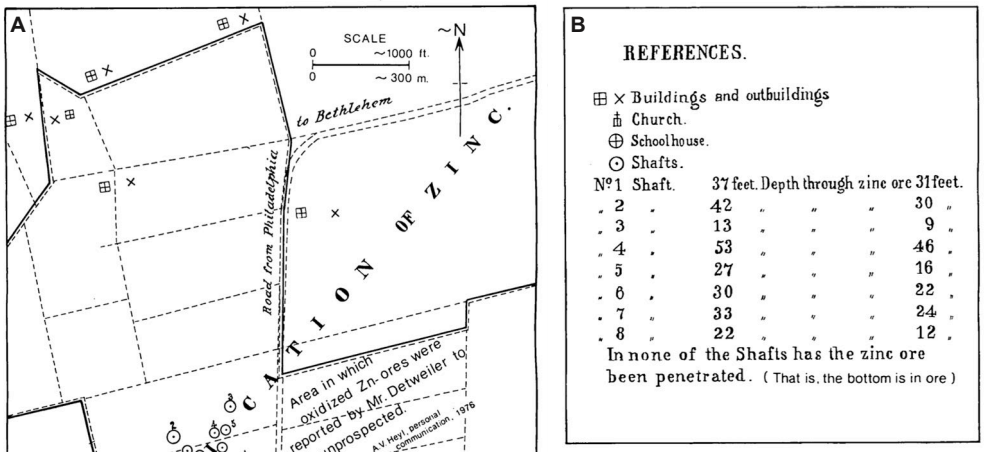



*Figure 2. A. An early map of zinc exploration and mining in the Friedensville district, Lehigh County, Pa. B. The explanation that accompanied the map. From Smith, 1977, fig. 53, p. 146–147.*

historical information, which included data on the Dickeson vein and the shaft by that name at New Galena. This shaft and vein name adds some support for the correct name being Montroville Dickeson because Montroville Dickeson wrote a report (1860b) on a Dickeson lead mine in Bucks County. During this period, was Montroville Dickeson superintendent of a zinc mine in Lehigh County, or of a lead mine in Bucks County, or both? As we will see, probably both, and more. In any case, Montroville Dickeson wrote an overly optimistic report on the vein he was developing at New Galena (Dickeson, 1860b, p. 6):

> "From the commencement of the sinking in the shaft, the lode gave a slight admixture of Suphuret of zinc or Blackjack [an old synonym for sphalerite]. At the depth of about twenty feet from the surface it had almost wholly disappeared, and at the extreme depth of the shaft, the evidence of its existence were so minute, as to afford the assurance, that no difficulty is to be apprehended from this positive enemy to perfect mineral formations."

This was written when zinc had little value relative to lead, and zinc was far more difficult to smelt into a usable metal or oxide. In a later report on the same Dickeson vein, "M. H. N." (unpublished manuscript, 1928, provided by Allen V. Heyl) observed the opposite. That is, the vertical zoning was such that zinc *increased* relative to lead at depth! In a series of articles, Allen V. Heyl (1997, 1998, 1999), then a retired economic geologist from the U.S. Geological Survey, reached similar conclusions.

We believe that the lanthanite-(Nd) finder was likely Dr. Montroville W. Dickeson, but we are not sure exactly from where in the Friedensville area it had come. All we can say with certainty is that a crumb from the original specimen was given to the senior author by Martin L. Anné, a former noted Pennsylvania mineral collector, and that crumb was the subject of the analyses reported here.

## MOTROVILLE WILSON DICKESON

Is there any other information available about a Dr. Montroville Wilson Dickeson (Figure 4) in Pennsylvania in this era? There was a medical doctor by that name who served honorably in Philadelphia during cholera epidemics but who was best known for his archaeological excavations of Native American mounds in the Ohio River valley. Unfortunately, it has been noted that "he was fond of exaggeration; in fact, at times he seems more showman than scientist" (Veit, 1999, p. 29). One analysis

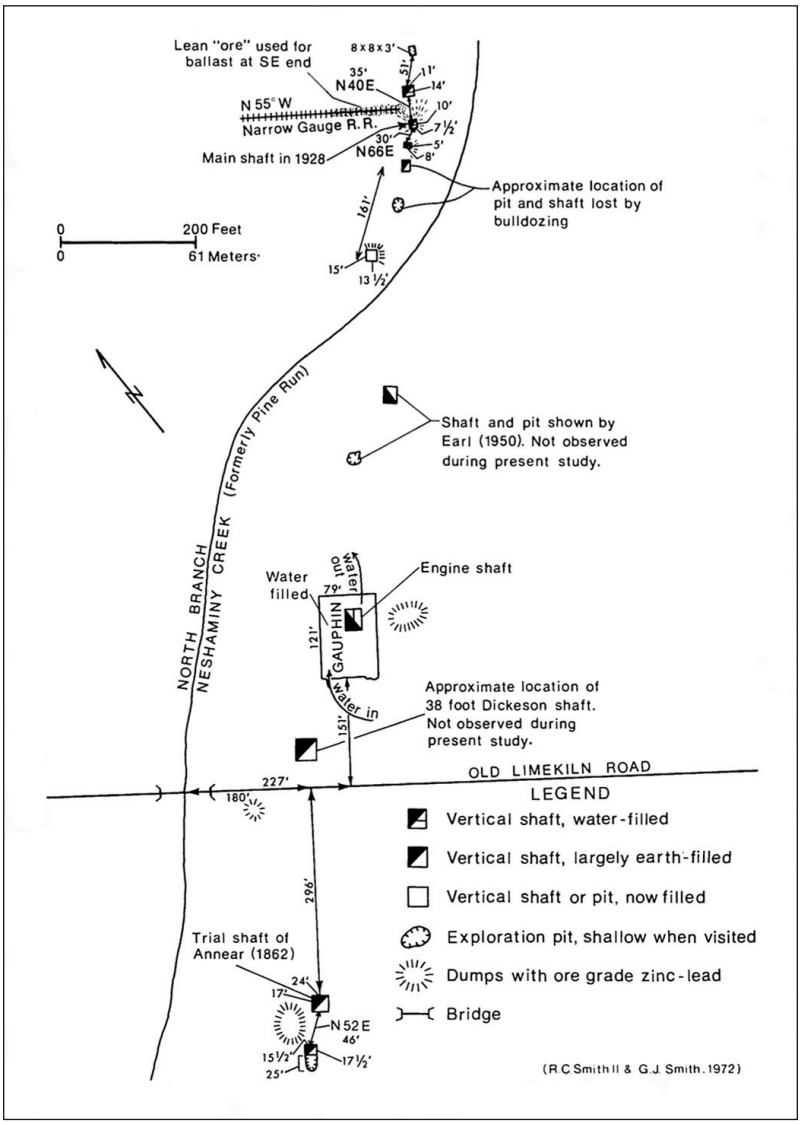



*Figure 3. Map of zinc-lead workings at the New Galena mine, Bucks County (from Smith, 1977, fig. 84, p. 240). This tape and compass map by R. C. Smith, II, and G. J. Smith was made in 1972 shortly before the North Branch Neshaminy Creek was flooded to create Lake Galena.*

of his archaeological work by Veit is even titled "A Case of Archaeological Amnesia …" (Veit, 1997), but another somewhat more positive summary by Veit (1999) is also available.

There was also a numismatist named Dr. Montroville Wilson Dickeson of Philadelphia who, in 1860, wrote the "American Numismatic Manual of the Currency or Money of the Aborigines, and Colonial, State, and United States Coins—With Historical and Descriptive Notices of Each Coin or Series." It is generally regarded as a valiant effort for its time, but, as with many pioneering studies, serious flaws were later noted. Less positive are reports of numismatist Dr. Montroville Wilson Dickeson having copies made of Continental currency coins and Summer Island shillings, even though those two reproductions were not considered to be deceptive to experts. Even less positive were his purchases of used, rusted coin and revenue stamp dies from the Philadelphia Mint to make "mules" (unpaired obverse and reverse coin dies used to make unnatural combination coins). Still less positive was his marketing 1858–60 United States half-cent coins that were illegally made by the night watchman at the Philadelphia Mint. Finally, and presumably the least positive, there were reports of Dickeson selling illegal restrikes of United States 1804 silver dollars for $75 each at his Philadelphia store (Breen, 1988, p. 10, 110–111, 158, 173, and 431). It is very likely that the mineral collector/mineral dealer/mining stock promoter/archaeologist/numismatist/esteemed medical doctor are one and the same person, Dr. M. W. Dickeson, whose name was also mistakenly recorded in the historical record as W. W. Dickenson and Mr. Dickson.

## THE IDENTIFICATION OF LANTHANITE-(Nd)

Despite the apparent dark shadows in Dr. Dickeson's background, Raymond Grant (see first paragraph) did verify that the mineral sold to Clarence Bement in 1867 by "Mr. Dickson" was lanthanite. Presumably, Grant accomplished this by X-ray powder diffraction. Separately, presumably using X-ray fluorescence, he determined that the predominant lanthanide element was neodymium with

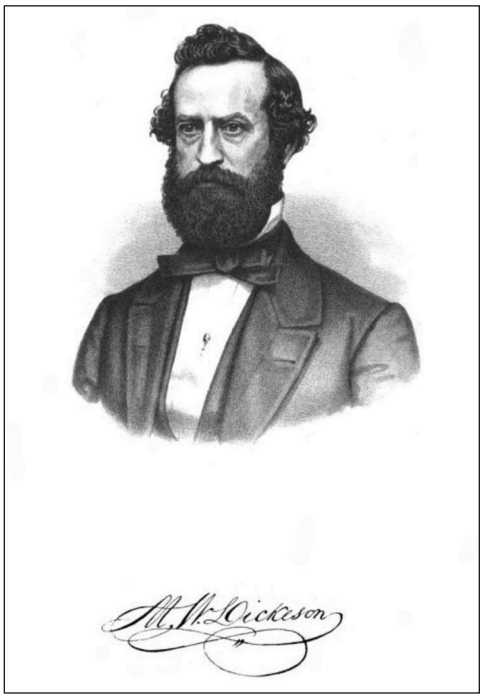


*Figure 4. Dr. Montroville Wilson Dickeson (from Dickeson, 1860a, frontispiece).*

minor lanthanum. Grant's analytical data and methods are not presently available, so we have attempted to provide our own quantitative results by SEM/EDS (scanning electron microscope/energy dispersive spectroscopy) in Table 1 and the image on page 1 (cover).

In addition to the unusual circumstance of recovery of only one specimen, the mineral itself is unusual in that the rare-earth element Nd predominates over the typically predominant rare earth cerium (Ce). Indeed, Ce is the predominant rare earth in allanite-(Ce) from several localities in eastern Pennsylvania (Smith, 1967) and in chevkinite-(Ce) from a few miles northeast of Friedensville (Smith and Barnes, 2019). Raymond Grant, while a graduate student of mineralogy at Harvard University, hypothesized that the Ce in the then-presumed precursor mineral to the lanthanite-(Nd) had been oxidized to $Ce^{4+}$ from the normal $Ce^{3+}$ found in most primary rare-earth minerals such as allanite (Montgomery, 1969, p. 67). In fact, with the exception of europium (Eu), which occurs in the $Eu^{2+}$ state, most of the other lanthanide elements occur only in the $3^{+}$ state in nature. In its oxidized $4^{+}$ state, the Ce might have been lost because of its greater solubility. Grant's geochemical hypothesis was well founded, and such oxidation is somewhat consistent with B. L. Miller's (1941) hypothesis that the primary source of the rare earths in the lanthanite was a downslope float boulder of allanite from the Reading Prong about a kilometer to the north. Miller reported that the lanthanite was found at a depth of about 6 feet in an *ochery* soil such as could be expected above sulfide ore deposits.

## THE LOCATION OF THE LANTHANITE-(Nd) DISCOVERY

Miller's (1941) geologic map of Lehigh County indicated that the Friedensville zinc ore deposits were in the Ordovician Beekmantown Group dolomites and limestones. More recently, Avery A. Drake, Jr. (1999), confirmed and extended more detailed geologic mapping around Friedensville originally done by geologists of the New Jersey Zinc Company. This more recent detailed mapping further resolved that the minable zinc ore was located in the Rickenbach Formation of the Beekmantown Group and that it was surrounded on three sides at the surface by the slightly younger Epler Formation of the Beekmantown Group. Recently, it has become known that the Epler Formation in this general area and adjacent New Jersey contains zones of primary sedimentary carbonate-fluorapatite nodules and that phosphate from them has been hydrothermally remobilized into voids in tectonic breccias as fluorapatite. Some of the known phosphatic zones yield ochery soils containing up to 125 ppm (parts per million) La, 150 ppm Ce, and 135 ppm Nd. Thus, it now seems that the lanthanite-(Nd) reported to have come from a shallow depth of an exploration shaft in the Friedensville area most likely came from an area having bedrock of the Epler Formation that was enriched in apatite and rare-earth elements. Such ochery soils observed in the past decade clearly have had their iron oxidized to $Fe^{3+}$ (thus, Grant was indeed onto something) based on their strong pigmentation properties. This oxidation would permit loss of the normally predominant $Ce^{4+}$. Further, a smectite-group mineral verified in the ochres in the Epler Formation would be expected to have strong ion-exchange properties enabling selective fractionation of individual rare earths. That is, Nd *might* be enriched relative to Ce in the ochery soils.

*Table 1. Scanning Electron Microscope/Energy Dispersive Spectroscopy Analyses (SEM/EDS) of Crystals of Lanthanite-(Nd) Reported to Have Been Collected at Friedensville, Lehigh County, Pa.*[1]

| Element | Near edge of larger crystal [2]S19–021–001 | Closer to center of larger crystal [2]S19–021–002 | Smaller crystal without Eu [2]S19–009–001 | Smaller crystal with Eu [2]S19–009–005 |
|---|---|---|---|---|
| C | 3.10 | 4.08 | 5.04 | 4.46 |
| O | 42.09 | 43.75 | 51.63 | 47.65 |
| Sr | .15 | .06 | .08 | .57 |
| Y | — | — | 8.67 | .56 |
| La | 13.45 | 13.50 | 9.48 | 13.20 |
| Ce | .89 | .71 | — | — |
| Pr | 9.52 | 8.24 | 4.81 | 6.14 |
| Nd | 26.34 | 24.50 | 18.01 | 22.08 |
| Sm | 2.18 | 2.89 | 1.49 | 3.22 |
| Eu | 1.48 | 1.40 | — | .90 |
| Gd | — | .41 | .14 | .99 |
| Tb | .26 | — | .18 | — |
| Dy | .17 | .22 | — | — |
| Ho | — | .24 | — | — |
| Er | — | — | .47 | — |
| Tm | .37 | — | — | .23 |
| Yb | — | — | — | — |
| Lu | — | — | — | — |

[1] Sample originally provided to senior author by M. L. Anné. Minor amounts of C (carbon) are unreliable by SEM/EDS, and even major amounts of O (oxygen) are suspect. All values are weight percent. A dash indicates an element concentration below the amount that could be reliably determined in a complex mixture.
[2] Pennsylvania Geological Survey analysis number

The lanthanite-(Nd) found in the Friedensville area of southern Lehigh County does not seem to have any apparent economic significance as a source of commercial rare earths—first and foremost because of the small amount observed, but also because land in the Friedensville area has been repurposed from mining to commercial development. Another factor reducing the possibility of economic significance is that almost any potential rare-earth enrichments in the area of the Reading Prong have a moderate probability of being enriched in nuisance amounts of uranium and thorium. Perhaps any commercial value of lanthanite-(Nd) from this area would be as mineral specimens!

## REFERENCES

Blake, W. P., 1853, On the occurrence of crystallized carbonate of lanthanum: American Journal of Science, 2nd ser., v. 16, p. 228–230.

Breen, Walter, 1988, Walter Breen's complete encyclopedia of U.S. and Colonial coins: New York, Doubleday, 754 p.

Dickeson, M. W., 1860a, American numismatic manual of the currency or money of the aborigines, and Colonial, state, and United States coins—With historical and descriptive notices of each coin or series, 2nd ed.: Philadelphia, J. B. Lippincott and Co., 271 p.

Dickeson, M. W., 1860b, Report of the geological survey of the Dickeson lead mine, Bucks County, Pennsylvania: Philadelphia, J. B. Chandler, 10 p.

Drake, A. A., Jr., 1999, Geologic map of the Allentown east quadrangle, Lehigh, Northampton, and Bucks Counties, Pennsylvania: U.S. Geological Survey Geologic Quadrangle Map GQ–1804.

Genth, F. A., 1857, Contributions to mineralogy: American Journal of Science, v. 2, no. 23, p. 415–427.

Heyl, A. V., 1997, Visits to the New Galena lead-zinc mines, Bucks County, Pa., Part 1, Background and earliest beginning [originally incorrectly subtitled 1930–1962]: Friends of Mineralogy, Pennsylvania Chapter, Newsletter, v. 25, no. 1, p. 3–6.

_____ 1998, Lead and zinc veins at New Galena, Bucks County, Pa., Part 2: Friends of Mineralogy, Pennsylvania Chapter, Newsletter, v. 26, no. 2, p. 3–7.

_____ 1999, The lead and zinc veins at New Galena, Bucks County, Pa., Part 3: Friends of Mineralogy, Pennsylvania Chapter, Newsletter, v. 27, no. 3, p. 2–7.

Miller, B. L., 1941, Lehigh County geology: Pennsylvania Geological Survey, 4th ser., County Report 39, 492 p.

Montgomery, Arthur, 1969, The mineralogy of Pennsylvania, 1922–1965: Academy of Natural Sciences of Philadelphia Special Publication 9, 104 p.

Smith, R. C., II, 1967, Geochemistry and mineralogy of allanite from the Durham-Reading Hills, Pennsylvania: Easton, Pa., Lafayette College, unpublished research paper, 26 p.

_____ 1977, Zinc and lead occurrences in Pennsylvania: Pennsylvania Geological Survey, 4th ser., Mineral Resource Report 72, 318 p. (especially p. 142–149 and p. 238–245).

_____ 2018, The New Galena lead-zinc mines, Bucks County, Pa., *part of* Anthony, R. V., ed., Temporal, tectonic, climatic, and environmental context of the Triassic-Jurassic rift system of eastern North America—Emerging concepts from the Newark rift basin: Field Conference of Pennsylvania Geologists, 83rd, Center Valley, Pa., as a link, Smith, 2018, New Galena Lead (Peace Valley Park) on the Field Conference of Pennsylvania Geologists web page (fcopg.org), or as a direct download at https://b7e3b42c-d915-4d5e-b566-0d870be2bfb9.filesusr.com/ugd/e9c798_9649d246fbd24020b2ab78eecb0e66d8.docx?dn=THE%20NEW%20GALENA%20LEAD.docx, accessed July 7, 2021.

Smith, R. C., II, and Barnes, J. H., 2019, A saga concerning the identification of chevkinite-(Ce), a rare-earth titanosilicate from Northampton County, Pennsylvania—Some rare-earth minerals in Pennsylvania, no. 1: Pennsylvania Geology, v. 49, no. 1, p. 3–11.

Veit, R. F., 1997, A case of archaeological amnesia—A contextual biography of Montroville Wilson Dickeson (1810–1882), early American archaeologist: Archaeology of eastern North America, v. 25, p. 97–123.

_____ 1999, Mastodons, mound builders, and Montroville W. Dickeson—Pioneering American archaeologist: Expedition Magazine, Penn Museum, v. 41, no. 3, p. 20–31, online at http://www.penn.museum/sites/expedition/?p=5853 (accessed September 21, 2021).

# BUREAU NEWS

## Bureau Staff Members Volunteer at Virtual Science Fair Events

As we entered 2021 with cautious optimism amid the COVID-19 pandemic, the organizers of the science fair events described in this article took full advantage of virtual communication platforms. Although the number of student participants in the first two events decreased by around 40 percent from early last year, these eager students were not going to let the uncertainty of the virus interfere with their ongoing research projects that could lead them to a bright future. In fact, these students inspired us with their desire and ability to think creatively, critically, and constructively to develop innovative solutions for a sustainable future.

### PENNSYLVANIA JUNIOR ACADEMY OF SCIENCE REGION 4 COMPETITION

The Pennsylvania Junior Academy of Science (PJAS) is a statewide organization founded in 1934. It was designed to stimulate and promote interest in science among 7th to 12th graders through the development of research projects and investigations. It is one of six regional fairs in the state. Dauphin County Technical School conducted the virtual PJAS Region 4 Competition, where students presented experiments of their choice with ten-minute (maximum allowed time) PowerPoint sessions detailing their findings by February 17. Virtual judging of these recorded presentations occurred February 20–March 6.

According to PJAS Director Emilie Tekely (email communication, 2021), a total of 77 students (36 in the junior division and 41 in the senior division) participated from 13 schools in Region 4 (Figure 1). Forty-five students captured first place awards, and 33 special awards amounted to $1,400. The next level of state competition at The Pennsylvania State University main campus was also virtual this year.

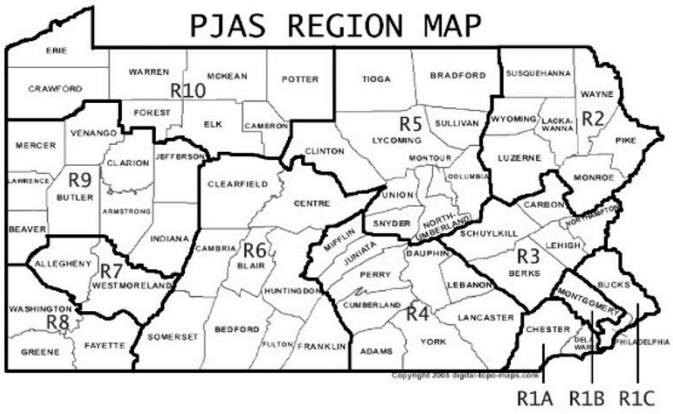



*Figure 1. Map showing the location of Region 4 (R4), from https://www.pjas.net/find-your-region. Used with permission from the Pennsylvania Junior Academy of Science.*

Staff geologist Antonette Markowski judged four 7th grade physics projects, and 60 other volunteers judged different projects at the PJAS Region 4 Competition. Two first-place topics included the discovery that ordinary freshwater algae during photosynthesis optimize performance of an algal anode by generating current into an existing closed circuit (as part of an operating battery); and what type of cup material keeps water the coldest.

Anyone interested in volunteering at the 2022 PJAS Regional Competition should contact Emilie Tekely at pjasr4director@gmail.com. For further information on PJAS judging, see the Pennsylvania Junior Academy of Science web page.

### CAPITAL AREA SCIENCE AND ENGINEERING FAIR

Staff geologists Victoria Neboga and Antonette Markowski engaged in virtual category judging of student PowerPoint presentations with 104 other judges and 68 special award judges at the 64th Capital Area Science and Engineering Fair (CASEF) (Figure 2) held March 2–9. The fair provided an


*Figure 2. Capital Area Science and Engineering Fair logo.*

opportunity for 147 aspiring young scientists from 26 schools out of 41 eligible counties to showcase their projects (72 junior high school students and 75 senior high school students, according to CASEF Director Valerie Knowles) (email communication, 2021).

Neboga judged four senior physics projects where students used their creativity and knowledge in these areas: the precision of ammunition, the effect of secondary cosmic rays on cloud cover, the use of the Miura-Ori origami fold pattern and its ability to expand in two dimensions, and finding the ideal shape of a rocket nozzle. Neboga recommended one senior project, "The Science of Art: Forces Against Origami Poisson Ratios" for the Dr. George Love Judge's Award. The student studied various Poisson ratios using sheets of paper that were tested by evenly distributed weights across the folded paper. This project won the CASEF Category Award for the top category projects sponsored by the Donald B. and Dorothy L. Stabler Foundation, along with another project, "Using Sugar Propellant to Determine the Ideal Shape of a Rocket Nozzle."

Markowski judged six senior life-science projects demonstrating practical life solutions ranging from heat versus poison for tick extermination to readily accessible clean water for third-world countries by testing homemade charcoal filters versus filtration and boiling water. Four projects were nominated as grand champions for advancement to the virtual Regeneron International Science and Engineering Fair (see RISEF in the next section for selected CASEF senior division grand champions). Four projects won first-place awards, and each of the six projects won a special award related to their particular topic. Examples of first-place category and associated special awards for senior life-science projects are the following: (1) Outstanding Biology Award to "Heat Versus Poison," (2) Senior Scholarship (5-year participant) to "Effect of Caffeine Compared to Apigenin on Metabolic Efficiency," (3) Conodoguinet Creek Watershed Association Award to "The Effects of Fermentation on Globally Invasive Algal Species and Environmental-Economic Applications," and (4) Life Science Award sponsored by the Donald B. and Dorothy L. Stabler Foundation to "What Factors Affect Vitamin C in Liquids?"

Eight CASEF junior division students won the Broadcom MASTERS (Math, Applied Science, Technology, and Engineering for Rising Stars) Middle School Competition Award. Since 2010 this national science competition has been affiliated with the Society for Science and the Public (SSP) and features the top 10 percent of United States middle school students. SSP has been dedicated to the achievement of young scientists in independent research and to public engagement in science since 1921. SSP is committed to inform, educate, and inspire through world-class competitions such as the Regeneron Science Talent Search, RISEF, and Broadcom MASTERS (as well as its award-winning magazines, *Science News* and *Science News for Students*). Junior division grand champions receiving cash awards from Sheetz are listed after the senior division grand champions at https://www.casef.org/awards-ceremony-1.

Seventy-three senior division CASEF students shared scholarship offers totaling $480,000 to Harrisburg University of Science and Technology. Other local and regional scientific, professional, industrial, educational, and governmental organizations sponsored $120,000 in special awards and scholarships (Valerie Knowles, email communication, 2021).

New judges, special awards, and sponsorships are always needed and welcome—especially needed is a sponsor for the judging portion of the fair. Please consider joining Bureau of Geological Survey staff

at next year's category judging in March 2022 by contacting Valerie Knowles at director@casef.org or 717–580–3812. For further information and confirmation of the CASEF event, see https://www.casef.org/ or email casef@hacc.edu.

## REGENERON INTERNATIONAL SCIENCE AND ENGINEERING FAIR


*Figure 3. Regeneron International Science and Engineering Fair logo.*

The 71st annual Regeneron International Science and Engineering Fair (RISEF), a program of Society for Science and sponsored by Regeneron Pharmaceuticals, was held May 16–21. Each May, nearly 2,000 high school students from about 70 countries and territories compete for scholarships, tuition grants, internships, scientific field trips, and grand prizes, including one $75,000 and two $50,000 college scholarships. All prizes together total $5 million in awards and scholarships in 21 scientific categories. Senior division grand champions representing CASEF at the virtual RISEF are highlighted at https://www.casef.org/awards-ceremony-1.

The opening ceremony of RISEF featured Maya Ajmera (President and CEO, Society for Science; Publisher, *Science News*), Dr. George Yancopoulos (cofounder, President, and Chief Scientific Officer, Regeneron Pharmaceuticals), and Dr. Michio Kaku (theoretical physicist, bestselling author, acclaimed public speaker, and renowned futurist). Panel events showcased excellence in science and technology, innovation and entrepreneurship, social innovation, and women in science, technology, engineering, and mathematics (STEM). Ceremonies for special awards and grand awards capped the event on May 20 and 21.

Staff geologist Antonette Markowski accepted an exciting virtual opportunity to proctor four 20-minute virtual interview sessions for various judges and student Nicole Camilliere from Ossining, N.Y., on May 6 prior to the main part of RISEF. Camilliere presented "Year-Long Salinization of Groundwater and Surface Waters of the Hudson River Watersheds Due to Chronic Road Salt Application" (poster at Investigating the Seasonal Dynamics of Sodium Chloride Concentrations in Hudson River Tributaries [nywea.org]). She found that high salt levels persist year round from continual road salt applications, impacting streams in highly urbanized watersheds across a gradient of watershed imperviousness. Interestingly, sodium and chloride concentrations can be more elevated in the summer than winter in urban streams, reflecting higher fractional contribution of groundwater to stream discharge.

# BUREAU NEWS

## New Staff Member

**Adam J. Ianno.** The newest staff member at the Pennsylvania Geological Survey is Adam J. Ianno. Adam came to the Economic Geology Division in the Middletown office of the Bureau in July 2021. He graduated from the University of Southern California with a Ph.D. in geological sciences and a graduate certificate in GIS and Technology. As a graduate from the University of Illinois at Urbana-Champaign with M.S. and B.S. degrees in geology, Adam looks forward to carrying the torch of Illinois representation at the Pennsylvania Geological Survey passed down from retired Bureau scientist Gary Fleeger. Adam joins the Bureau after eight years serving as an academic researcher, an entrepreneur and small-business owner, and a planetary-science data consultant.

Adam's interests in geology and science are diverse. He completed extensive structural field mapping of northern Joshua Tree National Park through two grants from the U.S. Geological Survey EDMAP program (a one-year, mentor-guided program designed to teach students geologic mapping techniques through rigorous field mapping). Follow-up projects using geochemistry, hornblende thermobarometry, and zircon geochronology of igneous and metamorphic rocks helped build a detailed story of the Mesozoic tectonic history of the Mojave Desert of California. He also pioneered the experimental design of non-traditional isotope geochemistry procedures in mineralized areas. He recently pursued award-winning "green chemistry" (low-solvent, low-waste) methods of isolating strategic or harmful elements from rocks, soils, and groundwater, and he taught chemistry and geology courses and mentored students in research.

Adam enjoys tinkering and building custom laboratory and camera equipment, the astrophotography of planets (on the three days a year the sky cooperates), 3D printing, Python programming, pottery, painting, photography, trying to climb all the high points in the United States, backpacking, and kayaking, among many other things.

# FROM THE STACKS . . .

Jody Smale, Librarian
Pennsylvania Geological Survey

Over the past year and a half, the Bureau library continued to provide materials for the staff and the public. Below is a list of publications acquired by the library during this time. Some of these resources were requested by Bureau staff to assist them with current projects, some were donated, and others were received as part of the library's journal subscriptions. So whether you are a geochemist, work with GIS, or just want to get out and explore the Susquehanna National Heritage Area, you will want to check out these resources available at our library.

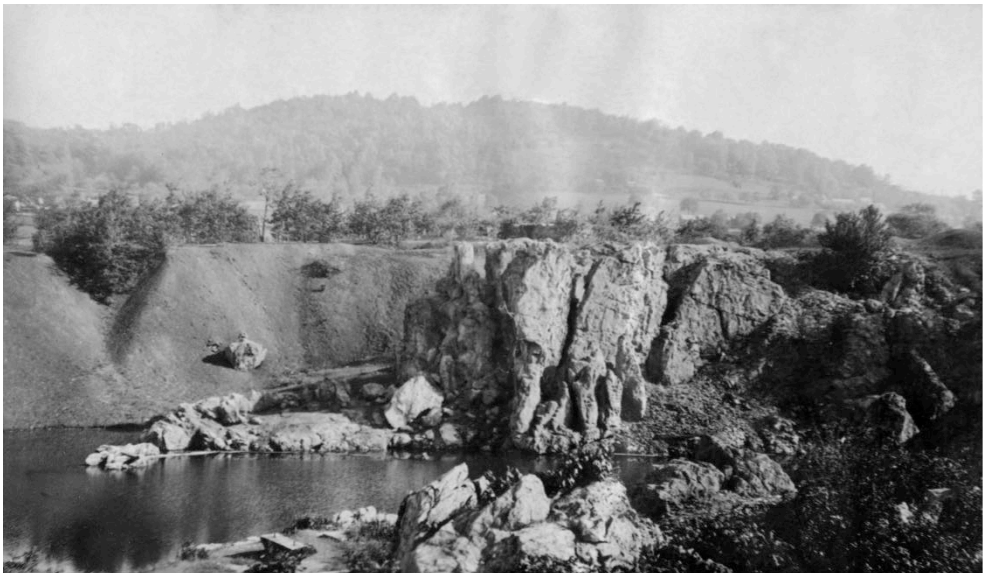
- ***Advanced Python scripting for ArcGIS Pro*** / Paul A. Zandbergen, Esri Press, 2020.
- ***Eurypterids illustrated—The search for prehistoric sea scorpions*** / Samuel J. Ciurca, Jr., Paleo Research, 2010.
- ***Geologic guide—Northwest Lancaster County River Trail, Columbia to Falmouth, Pa.*** / Jeri L. Jones, Year of the Book, 2020.
- ***GIS and geocomputation for water resource science and engineering*** / Barnali Dixon and Venkatesh Uddameri, Wiley, 2016.
- ***Reactive transport in natural and engineered systems*** / edited by Jennifer Druhan and Christophe Tournassat, Mineralogical Society of America Reviews in Mineralogy and Geochemistry, v. 85, 2019.
- ***Semiology of graphics—Diagrams, networks, maps*** / by Jacques Bertin, translated by William J. Berg, Esri Press, 2011.
- ***Site characterization in karst and pseudokarst terraines—Practical strategies and technology for practicing engineers, hydrologists and geologists*** / Richard C. Benson and Lynn B. Yuhr, Springer, 2016.
- ***Triple oxygen isotope geochemistry*** / edited by Ilya N. Bindeman and Andreas Pack, Mineralogical Society of America Reviews in Mineralogy and Geochemistry, v. 86, 2021.

# RECENT PUBLICATION

**Trail of Geology (July 2021)**

- A tale of two terranes—A river guide to the geology of the Yellow Breeches Creek from Spangler's Mill to New Cumberland (PDF)

# A Look Back in Time



This photograph of the Ueberroth pit of the Friedensville zinc mines was taken by Bureau geologist Charles Karsner Graeber on May 30, 1932. The mine was located on the farm of Jacob Ueberroth, for whom the mine was named. "The Uberroth Mine was the first, largest, and most profitable of the Friedensville mines" and "operated continuously from 1853 to 1876" (Kaas, 2016).

To learn more about the Friedensville zinc mines, please see these additional resources available online and in the Bureau library:

Kaas, L. M., 2016, The history of zinc mining in Friedensville, Pennsylvania: The Mining History Journal, v. 23, p. 17–42, available at https://www.mininghistoryassociation.org/Journal/MHJ-v23-2016-Kaas.pdf, accessed August 13, 2021.

Metsger, R. W., Willman, A. H., and Van Ness, C. G., 1973, Field guide to the Friedensville mine of the New Jersey Zinc Company: Allentown, Pa., Northeast Section of Geological Society of America, pre-meeting field trip, 19 p.

Miller, B. L., 1924, Lead and zinc ores of Pennsylvania: Pennsylvania Geological Survey, 4th ser., Mineral Resource Report 5, 91 p.

_____ 1941, Lehigh County Pennsylvania—Geology and geography: Pennsylvania Geological Survey, 4th ser., County Report 39, 492 p.

Smith, R. C., II, 1977, Zinc and lead occurrences in Pennsylvania: Pennsylvania Geological Survey, 4th ser., Mineral Resource Report 72, 318 p.

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.

Director
Bureau of Geological Survey
3240 Schoolhouse Road
Middletown, PA 17057
Telephone: 717–702–2017

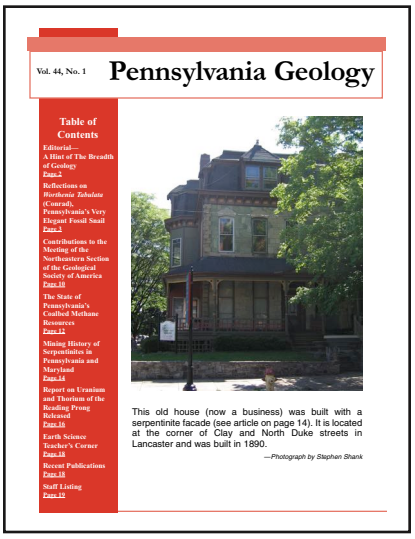

Vol. 44, No. 1 Pennsylvania Geology

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

# Department of Conservation and Natural Resources
# Bureau of Geological Survey

**Main Headquarters**
3240 Schoolhouse Road
Middletown, PA 17057–3534
Phone: 717–702–2017

**Pittsburgh Office**
400 Waterfront Drive
Pittsburgh, PA 15222–4745
Phone: 412–442–4235

## DIRECTOR'S OFFICE

| **Director and State Geologist** | | **Administrative Services** | |
|---|---|---|---|
| Gale C. Blackmer, Ph.D., P.G. | 717–702–2017 | Connie F. Cross | 717–702–2054 |
| | | Jody R. Zipperer | 717–702–2073 |

## GEOLOGIC AND GEOGRAPHIC INFORMATION SERVICES

Vacant

| **GIS Services** | | **IT and Database Services** | |
|---|---|---|---|
| Craig M. Ebersole, P.G. | 717–702–2023 | Sandipkumar P. Patel | 717–702–4277 |
| Ellen R. Fehrs | 717–702–2025 | Mark A. Dornes | 717–702–4278 |
| Caron E. Pawlicki, P.G. | 717–702–2042 | David F. Fletcher | 412–442–5826 |
| **Core Library Services** | | **Library Services** | |
| John C. Neubaum | 717–702–2039 | Jody L. Smale | 717–702–2020 |

## GEOLOGIC MAPPING

Stuart O. Reese, P.G., 717–702–2028

| **Stratigraphic Studies** | | **Groundwater and Environmental Geology** | |
|---|---|---|---|
| Kristen L. Hand | 717–702–2046 | Simeon B. Suter, P.G. | 717–702–2047 |
| Aaron D. Bierly | 717–702–2034 | Rose-Anna Behr, P.G. | 717–702–2035 |
| Clifford H. Dodge, P.G. | 717–702–2036 | Helen L. Delano, P.G. | 717–702–2031 |
| James R. Shaulis, P.G. | 717–702–2037 | Ty C. Johnson, P.G. | 717–702–2045 |
| | | Victoria V. Neboga | 717–702–2026 |

## ECONOMIC GEOLOGY

Kristin M. Carter, P.G., C.P.G., 412–442–4234

| **Mineral Resource Analysis** | | **Petroleum and Subsurface Geology** | |
|---|---|---|---|
| Stephen G. Shank, Ph.D., P.G. | 717–702–2021 | Robin V. Anthony | 412–442–4295 |
| Adam J. Ianno, Ph.D. | 717–702–2033 | Katherine W. Schmid, P.G. | 412–442–4232 |
| Leonard J. Lentz, P.G. | 717–702–2040 | | |
| Antonette K. Markowski, P.G. | 717–702–2038 | | |

PENNSYLVANIA GEOLOGY is published quarterly by the
Bureau of Geological Survey
Department of Conservation and Natural Resources
3240 Schoolhouse Road, Middletown, PA 17057–3534.

This edition's editor: Anne Lutz, Ph.D., P.G.

Links to websites were valid as of the date of release of this issue.

Contributed articles are welcome.

To subscribe, send an email to RA-pageology@state.pa.us.





Bureau website: www.dcnr.pa.gov/Geology/Pages/default.aspx
DCNR Facebook page: www.facebook.com/padcnr/
DCNR website: www.dcnr.pa.gov/Pages/default.aspx
Pennsylvania home page: www.pa.gov