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Pennsylvania Geology

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It was a day of exploration for both adults and children, who were looking for fossils at a site near Beltzville State Park. The activity was part of a special program to introduce the public to the study of paleontology (see article on page 18).

—Photograph by MaryAnn Haladay-Bierly

EDITORIAL

The Year in Review

Gale C. Blackmer, State Geologist
Pennsylvania Geological Survey

As we all prepare to go into hibernation for the winter, I would like to take this opportunity to look back on 2017. It was a busy year for the Survey. We said good-bye to John Barnes as a regular staff member and welcomed him back as a volunteer. We welcomed Sim Suter as the new supervisor of the Groundwater and Environmental Geology Section in the Mapping Division. We cheered Stuart Reese as he "moved up" to become manager of the Mapping Division. As befits his new position, Stuart completed his first submission of a StateMap proposal to the U.S. Geological Survey (USGS), and he still has a few hairs left on his head!

The bureau released nine publications in 2017: two atlas reports, one mineral resource report, five bathymetric maps of state park lakes, and a rail-trail geologic guide in the Trail of Geology series. Staff geologist Rose-Anna Behr was author or co-author on eight of those nine publications. We may squeeze out one or two more before the end of the year.

Mapping Division staff worked on a number of projects around the state. The largest was the completion of bedrock geologic maps of six quadrangles in northeastern Susquehanna County, submitted in draft form to the USGS in fulfillment of our 2016 grant through the StateMap program. The division started work on our two 2017 StateMap projects: mapping in the areas of the Tangascootack basin in Clinton County and the Rich Valley quadrangle in Cameron County. We used a grant from the Department of Environmental Protection (DEP) to gather drilling records and other data in anticipation of a major mapping effort in the Broad Top area to start next year. Mapping of bedrock topography within the Late Wisconsinan glacial border in northwestern Pennsylvania, using funding through the Great Lakes Geologic Mapping Coalition (another USGS program), was finished in Warren County and has been started in Lawrence County. This year, the division focused on adding data on Pennsylvania's springs to the Pennsylvania Groundwater Information System (PaGWIS). Since January, 45 springs have been added to the database, and information was updated for 28 others. PaGWIS now contains information for 1,940 springs. The groundwater staff also concentrated on providing water-supply assistance to the Bureau of State Parks. This assistance has included researching a new well location, water-well construction and development, and existing well rehabilitation.

The Economic Geology Division partnered with the West Virginia and Ohio geological surveys to successfully complete a one-year geologic study to determine the potential to create an Appalachian Storage Hub for natural-gas liquids in the tristate area. The research team identified potential reservoirs for the secure storage of petroleum hydrocarbons that would serve petrochemical "cracker" plants. These plants convert natural gas to ethylene, which is used as a building block for a wide range of products, from plastics to antifreeze. Division staff also continued their work in the Midwest Regional Carbon Sequestration Partnership and the Mid-Atlantic U.S. Offshore Carbon Storage

(continued on page 17)

The Half-Century Anniversary of Project Ketch—A Proposal to Create Natural-Gas Storage in North-Central Pennsylvania Through Nuclear Detonation

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FOREWORD

Some of us are old enough to remember the 1950s and the days of "duck and cover." These were very tense times because of serious concerns of a nuclear weapons exchange between the USSR (Union of Soviet Socialist Republics) and the United States. There were also concerns related to the potential health effects from weapons testing and radioactive fallout. As the Cold War "cooled off," international treaties were signed, and aboveground testing of nuclear weapons moved (literally) underground, the Atomic Energy Commission's (AEC) scientific and weapons laboratories began to look at the peaceful uses for these nuclear explosives. Project *Plowshare* was the name given by the AEC to this effort, and nearly 30 nuclear projects were performed at the Nevada test site and at off-site locations in Nevada and other states. Rock blasting for the stimulation of natural-gas formations and creation of gas-storage chambers was considered and actually carried out in a few locations. Needless to say, some of these tests generated significant public opposition.

"My God, right here in Pennsylvania."

That was the reaction of Nunzio J. Palladino, Penn State Dean of Engineering, on learning in 1966 of a proposal, Project Ketch, to explode a nuclear device in Pennsylvania's Sproul State Forest.[1] Its purpose? To create an underground cavern for natural-gas storage. Thomas M. Gerusky, Director of the state's Division of Radiation Protection, later wrote:

> "However, after we recovered from the initial shock and began to consider the situation in more detail, we all realized it was not our responsibility to react from emotion, but only from cold, hard fact and reason. What were our responsibilities? Only one—to evaluate the experiment from the standpoint of public health and safety and approve or disapprove of the proposal."[2]

Project Ketch was a part of the U.S. Atomic Energy Commission's *Plowshare* program to utilize nuclear explosions for peaceful purposes. The following article takes us back half a century to when *Plowshare* was in full swing—and Pennsylvania found itself at ground zero of a *Plowshare* proposal, Project Ketch. While other states hosted experimental explosions of nuclear devices under *Plowshare,* Project Ketch did not happen. Factors other than public health and safety contributed to this ending. Nonetheless, Pennsylvania's independent, systematic, transparent appraisal of the proposal from a public

[1] John B. Krygier, 1998, Project Ketch—Project *Plowshare* in Pennsylvania: Ecumene v. 5, no. 3, p. 311–312, https:/www.researchgate.net/publication/249821372_Project_Ketch_Project_Plowshare_in_Pennsylvania.
[2] Thomas M. Gerusky, 1969, Role of a State Health Department in an Underground Nuclear Experiment: *in* Proceedings for the Symposium on Public Health Aspects of Peaceful Uses of Nuclear Explosives, Las Vegas, Nev., p. 729–735, https://inis.iaea.org/search/search.aspx?orig_q=RN:37015917.

health and safety standpoint established the basis for the Governor's determination that the state would have a role in deciding whether the project would proceed.

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INTRODUCTION

Most instances of natural-gas history in Pennsylvania are notable for what did happen; the following is one that is just as notable for what didn't. In this case, a U.S. President's speech in December 1953, combined with both a U.S. Supreme Court decision made just six months later and a 1966 Pennsylvania law, apparently set into motion a chain of events that led to the serious consideration of the underground detonation of a nuclear device in north-central Pennsylvania for the purpose of creating a natural-gas storage cavern by the end of the 1960s.

THE STAGE IS SET

The President was Dwight D. Eisenhower, lauding an "Atoms-for-Peace" proposal in his speech to the United Nations General Assembly on December 8, 1953 (Buck, 1983, p. 6).

The 1966 Pennsylvania law (Laws of Pennsylvania, 1966, referenced hereafter as Act 578) was "The Atomic Energy Development and Radiation Control Act," signed by Governor William W. Scranton, the stated purpose of which was "to encourage the development and use of atomic energy for peaceful purposes, consistent with the health and safety of the public."

The court ruling was Phillips Petroleum Co. v. Wisconsin, 347 U.S. 672, decided on June 7, 1954 (U.S. Supreme Court, 1954), which determined that the Federal Power Commission (predecessor to FERC, the Federal Energy Regulatory Commission) was authorized under the Natural Gas Act of 1938 to regulate the wellhead price of natural gas sold into interstate pipelines.

This court ruling resulted in natural gas being kept at artificially low prices, making it attractive to consumers while increasing demand for the fuel, particularly in the post-World War II economy. But with profits effectively constrained, there was little incentive for drilling companies to explore for additional supplies; the risk of dry holes or only marginally profitable ones was a substantial one. These factors of supply and demand combined to create natural-gas shortages in the 1960s, with additional anticipated ones being projected into the 1970s. These circumstances made natural-gas storage a valuable commodity, particularly in meeting peak demand along the east coast during the winter months (Joskow, 2013; NaturalGas.org, 2013).

PROJECT *PLOWSHARE*—PEACEFUL NUCLEAR WEAPONS APPLICATIONS

President Eisenhower's Atoms-for-Peace initiative eventually fissioned into *"Plowshare"* (Figure 1), a program created in 1957 by the Atomic Energy Commission (or AEC, the predecessor agency to both the Nuclear Regulatory Commission, or NRC, and the Department of Energy). The Project *Plowshare* name originated from two Biblical passages (Isaiah 2:4 and Micah 4:3) that reference the "beating of swords into plowshares." The program's purpose was to determine the feasibility of using the knowledge and technology resulting from the development of nuclear weapons during both World War II and the

Figure 1. Sculpture by Moissaye Marans, titled "Swords into Plowshares," which was chosen as the symbol for Project Plowshare *(from Gerber and others, 1966, cover).*

Cold War for peaceful and economically more affordable purposes, such as blasting roadcuts, creating canals, quarrying, and other underground engineering projects (West and Kelly, 1969, p. v; U.S. Department of Energy [no date], p. 2).

In its first three years, the *Plowshare* program was subject to a nuclear weapons testing moratorium put in place by President Eisenhower; during that time, several nonnuclear conventional high explosive tests using TNT or nitromethane were conducted instead. Between the time when the moratorium ended in 1961 and the program's official end in 1975, at least two dozen "peaceful" nuclear tests were carried out under project names such as Gnome, Sedan, Vulcan, Schooner, and Gasbuggy. An approximately equal number of nuclear tests were proposed but never executed, including ones with names like Oxcart, Dogsled, Wagon Wheel, Sloop, and Ketch—the latter two of which were named after types of masted sailing ships (Buck, 1983; U.S. Department of Energy [no date], p. 1–25).

A PROPOSED PENNSYLVANIA *PLOWSHARE* PROJECT

The geologic properties of certain depleted natural-gas production fields lend themselves to conversion into storage fields, where natural gas is pumped in during low-demand periods (typically summer) and extracted during high-demand periods (typically winter). Storage fields aren't necessarily located conveniently near large consumer markets (such as the eastern seaboard) for the gas.

One company challenged by meeting the energy needs of its customers in Pennsylvania and elsewhere in the 1960s was Columbia Gas System Service Corporation (Columbia Gas). One of this company's subsidiaries, Manufacturers Light and Heat Company (MLH), was operating seven of 61 active natural-gas storage fields in Pennsylvania at the end of 1960. Six of MLH's storage fields were located in the southwestern corner of Pennsylvania (Greene, Washington, and Westmoreland Counties), and one was located in Jefferson County. The combined working gas volume (i.e., that amount of natural gas available to be marketed) of these seven fields at that time was approximately 18,300 Mcf (1 Mcf = 1,000 cubic feet of gas). At the same time, and by comparison, the Leidy storage field complex located along the Clinton County/Potter County boundary (operated by companies other than Columbia Gas) had a working gas volume of 54,000 Mcf, nearly three times that of MLH's fields combined (Lytle, 1962; Columbia Gas of Pennsylvania, 2017).

Columbia therefore began contemplating the artificial creation of a natural-gas storage cavern through the detonation of an underground nuclear explosive device. If such methodology was proved to be safe and both economically and technologically feasible, it could be replicated elsewhere in the United States where access to stored gas would not need to be dependent on proximity to depleted production fields.

In early 1964, Columbia Gas began discussions with the AEC. A September 28, 1965, press release originating from the AEC stated that a "preliminary industry-government feasibility study has been initiated to investigate the potential use of a deeply buried nuclear explosion to create an underground

natural gas storage reservoir." The press release listed the Columbia Gas System Service Corporation, the AEC, and the Lawrence Radiation Laboratory in Livermore, Calif., as partners in the study. Locations being evaluated for this study included several mid-Atlantic states that were located within Columbia Gas's service territory at the time, including Pennsylvania (Pennsylvania Department of Conservation and Natural Resources, Bureau of Forestry, unpublished program files).

PENNSYLVANIA PROJECT SITE SELECTION AND FEASIBILITY PROPOSAL

Discussions with the Commonwealth of Pennsylvania regarding the selection of a site for the feasibility study to be located within the state began in early 1966 and primarily involved representatives from the Pennsylvania Department of Commerce (Act 578 of 1966 tasked this agency with "the promotion and development of atomic energy resources" within the state), the Pennsylvania Department of Health (Radiological Division), the Pennsylvania Department of Forests and Waters (predecessor agency to today's Bureau of Forestry), the Pennsylvania Geological Survey (represented by then State Geologist, Arthur Socolow), and the U.S. Geological Survey, among others (Gerusky, 1969, p. 730–731).

Columbia Gas had a particular site in mind. Within three years following discovery of the Leidy Oriskany gas field in 1950, MLH drilled at least two deep exploratory wells (API numbers 37–035–90027 and 37–035–90008) at locations adjacent to the company's pipeline in Beech Creek Township, Clinton County, approximately 20 miles south-southeast of the Leidy field. These wells were drilled along the strike of the Hyner dome to depths averaging about 8,000 feet belowground, but they came up dry and were plugged. However, the lithologic data collected during the drilling of these wells may have loaned itself to later use by the company in selecting the location and depth interval of interest for the proposed cavern.

Pennsylvania newspapers began reporting on the project circa February 1967 (Figure 2) while meetings between the parties continued. In late June 1967, a tour of several former nuclear test sites in Nevada was conducted, which included two members of the Project Ketch Subcommittee of the Advisory Committee on Atomic Energy Development and Radiation Control as part of the project's consideration by the commonwealth (Pennsylvania Department of Conservation and Natural Resources, Bureau of Forestry, unpublished program files; memorandum and unpublished review of Phase I of the "Project Ketch Safety Concept" of August 3, 1967, in the Pennsylvania State Library, PGV 1.2, R454p).


EXPLOSION WOULD CREATE GAS STORAGE AREA 2-14-67

Underground Nuclear Blast In Centre County Studied

Figure 2. Headline from a 1967 newspaper.

A feasibility study outlining the economics of the proposal, its location and geologic setting, the theorized resultant radioactivity, and the time frame associated with the project were summarized in a July 1967 report put out jointly by Columbia Gas, the AEC, the U.S. Bureau of Mines, and the Lawrence Radiation Laboratory at the University of California (Forrest and Hague, 1967).

The project was given the *Plowshare* name of "Ketch," and the selected site was located within the Sproul State Forest, in Beech Creek Township, Clinton County, near its border with Centre County

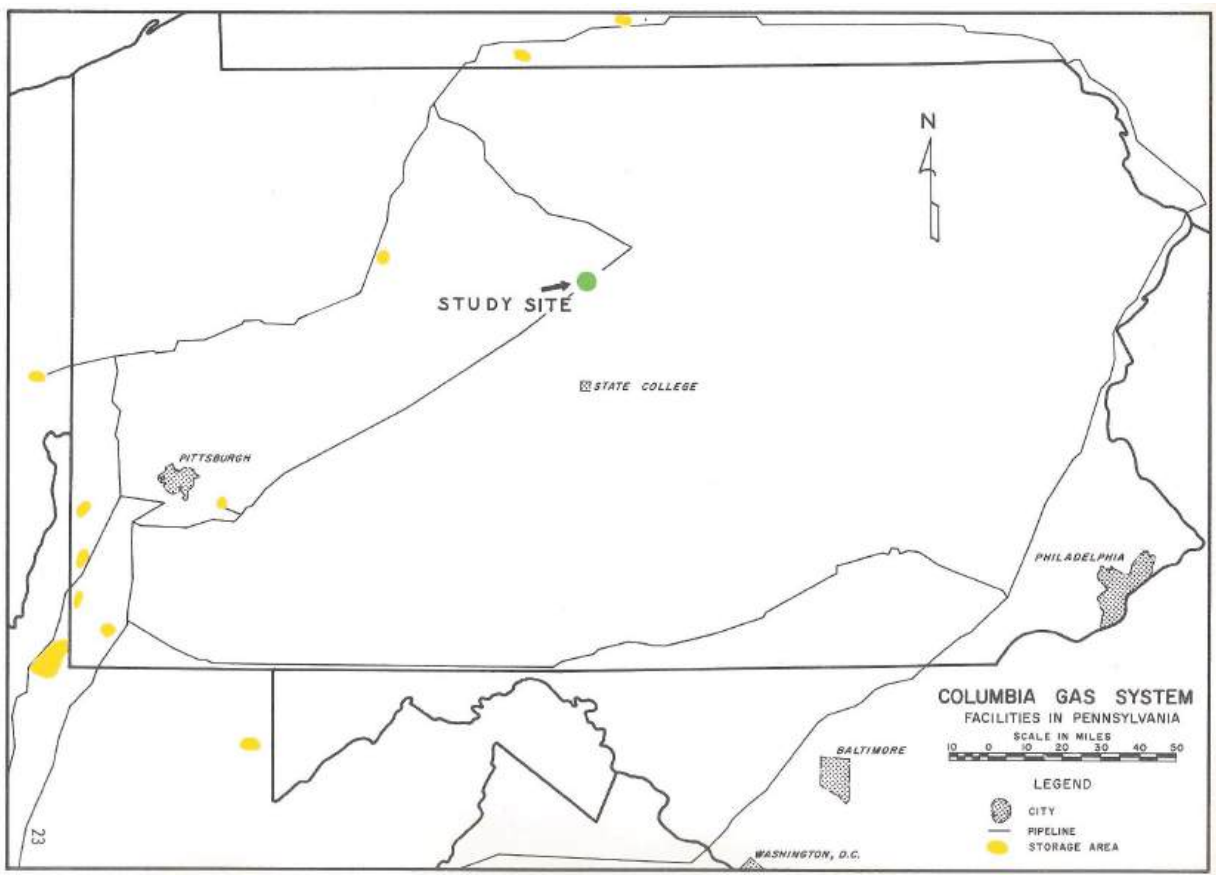


Figure 3. Map from the July 1967 Project Ketch feasibility study (Forrest and Hague, 1967, Figure 5), showing the location of the proposed site relative to Columbia Gas natural-gas storage fields (in yellow). Pennsylvania's numerous other storage fields, including the large Leidy/Tamarack/Downs/Greenlick field complex on the Clinton County/Potter County border, are not shown on this map.

(Figures 3 and 4) (Forrest and Hague, 1967). Project Ketch was the only *Plowshare* project proposed for the east coast of the United States (U.S. Department of Energy [no date]) and at the time, it was only one of a small number of *Plowshare* projects geared more toward economic considerations rather than military ones. Most other *Plowshare* projects were also proposed for or occurred on lands owned and controlled by either the AEC or the federal government, versus lands under state jurisdiction or private ownership (U.S. Department of Energy [no date]; Report on Project Ketch meeting, "Nuclear excavation for underground gas storage," January 24, 1967, unpublished data).

Should the results of the feasibility study have met certain criteria, the project could have resulted in a 24-kiloton nuclear device being detonated for the purpose of creating an underground natural-gas storage cavern to be owned and operated by Columbia Gas.

PROPOSED PROJECT GEOLOGY DETAILS

The 1967 feasibility study included the location of the proposed project as being along the southwestern limb of the Hyner anticline (Forrest and Hague, 1967), a large structural feature oriented roughly northeast-southwest that bisects northern Clinton County (Ebright, 1952, p. 1). It is also located

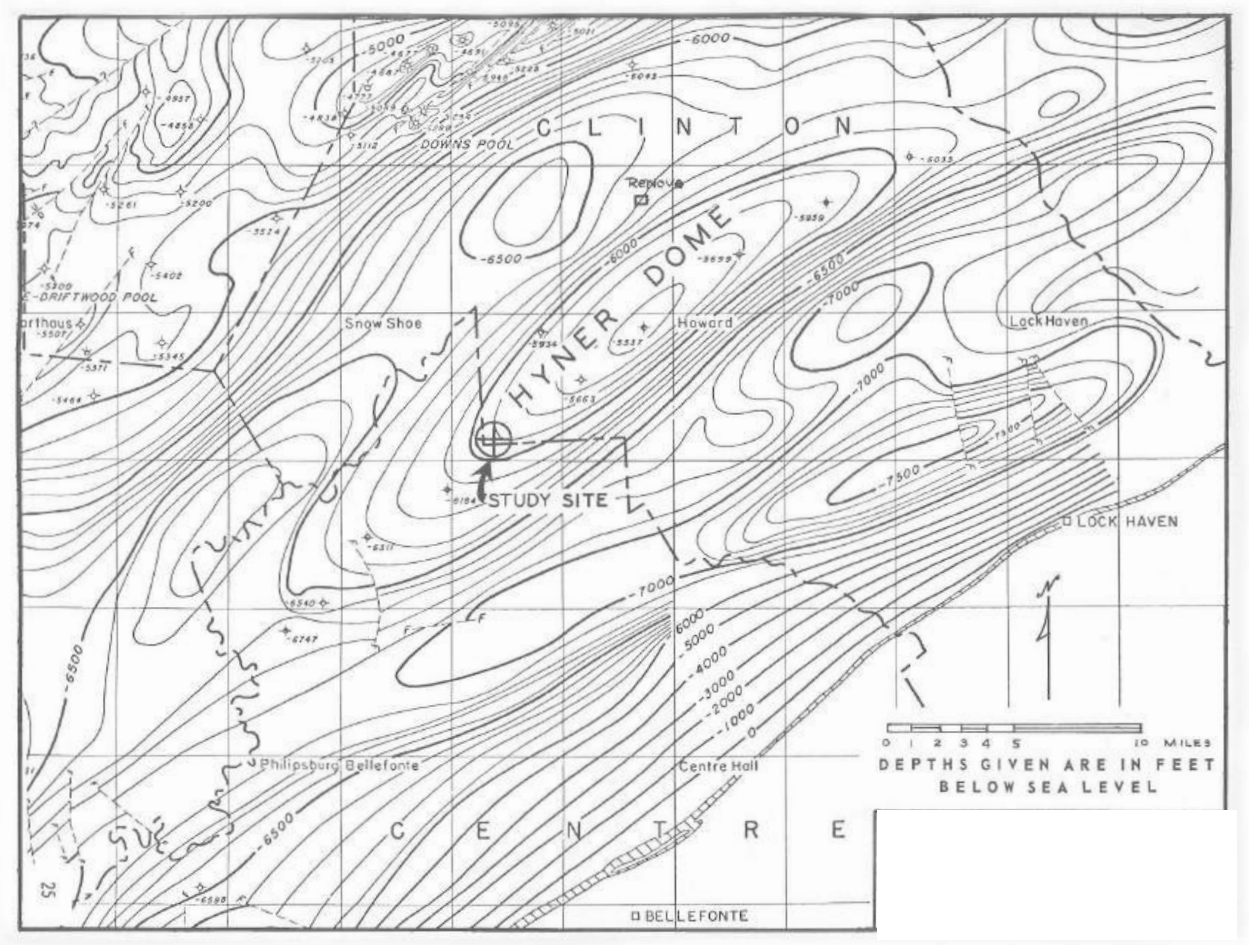


Figure 4. Subsurface structure on the top of the Oriskany Formation in Clinton and Centre Counties, Pa. (modified from Forrest and Hague, 1967, Figure 7).

south of the Leidy gas field complex, an Oriskany sandstone discovery made in January 1950 that was converted to natural-gas storage within a decade (Cathcart, 1950, p. 1; Lytle and others, 1961, p. 15).

The study indicated that the proposed depth of the shot was planned for approximately 3,300 feet belowground. The geological cross section in Figure 5 shows that the "Chemung Portage" Groups were targeted for the cavern's formation. These group names of previous workers have since been supplanted by Lock Haven Formation and Brallier Formation, respectively; the detonation zone corresponds with the Lock Haven Formation (Clifford Dodge, personal communication, January 21, 2014).

As explained in the feasibility study, this zone was targeted because of its anticipated low permeability surrounding the chimney's formation following the shot, the character of which would lend it to containing natural gas injected for storage (Forrest and Hague, 1967).

The cavern itself was predicted to take the form of a rubble-filled "chimney" having dimensions of approximately 300 feet in height and a radius of about 90 feet (Figures 6, 7, and 8). This centralized void space, combined with fractures extending out for distances of up to 650 feet, was anticipated to be able to accommodate about 465,000 Mcf of natural gas (Forrest and Hague, 1967, p. i). This volume, combined with that of Columbia Gas's other seven smaller storage fields, would have rivaled that of the Leidy storage field complex.

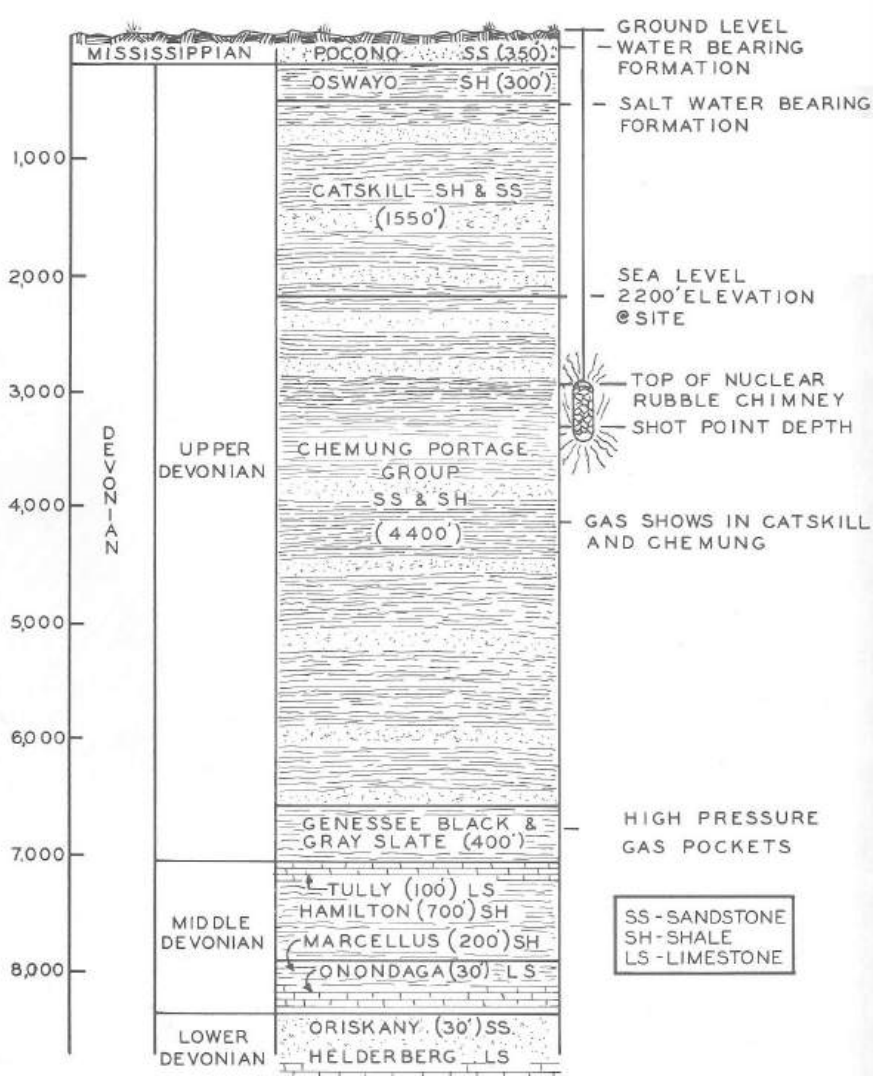


Figure 5. Geological cross section at the test site on Sproul State Forest land in Beech Creek Township, Clinton County (from Forrest and Hague, 1967, Figure 8).

CONDITIONAL PROJECT APPROVAL AND TIME FRAME

In a letter and press release dated August 11, 1967, and addressed to the U.S. Atomic Energy Commission, Governor Raymond P. Shafer granted conditional approval to use the Sproul State Forest for Phase I (see below) of the project based on certain conditions, the most important of which was that should the results of the Phase I site evaluation not demonstrate that the project would be in the best interests of the commonwealth, the state reserved the right to refuse permission for the project to proceed any further.

The parties involved began working the terms of a lease with the commonwealth, which was speculated to be finalized in early 1968. Until a lease was put in place, no actual intrusive site evaluation could take place (Lytle and others, 1968, p. 24).

The project was anticipated to take place in five phases following the execution of a lease contract, as follows (Forrest and Hague, 1967, p. 29–30):

- Phase I (8 months)—physical site evaluation to determine site characteristics and feasibility;
- Phase II (6 months)—field construction, borehole drilling, and detonation;
- Phase III (11 months)—cavern measurements and other post-shot evaluations;
- Phase IV (6 months)—development of the gas-storage facility;
- Phase V (14 months)—facility operation and data evaluation.

In the months following the commonwealth's approval letter, numerous public-information meetings were held and the project received more media attention. Letters and petitions of opposition to the project were sent in by concerned citizens, residents, fishing and hunting clubs, academia, and others

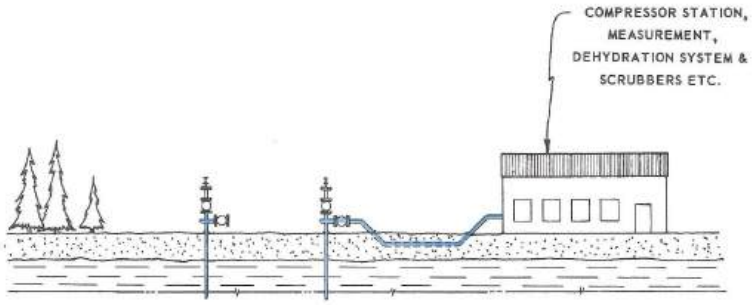
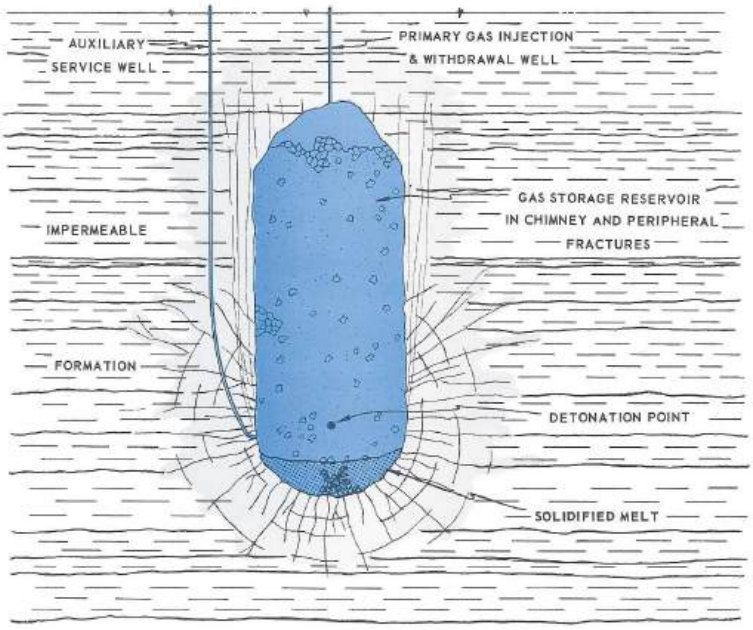


Figure 6. Gas storage in a nuclear reservoir (from Forrest and Hague, 1967, Figure 4).



(Pennsylvania Department of Conservation and Natural Resources, Bureau of Forestry, unpublished program files).

PROJECT KETCH'S QUICK DECAY AND THE END OF *PLOWSHARE*

A lease for the proposed project Ketch was never finalized or executed, and no on-the-ground work was ever completed; that is, Phase I was never begun.

The feasibility of Project Ketch had been largely dependent on the results of Project Gasbuggy (Pennsylvania Department of Conservation and Natural Resources, Bureau of Forestry, unpublished program files), which was a similar underground nuclear detonation that took place on December 10, 1967, in the Carson National Forest in northwest New Mexico. The purpose of that experiment was to evaluate belowground nuclear explosions as a means by which to stimulate a low-permeability natural-gas producing formation (Rawson and other, 1969). One researcher later remarked, "The post-shot geologic investigations at Gasbuggy have also emphasized the importance of understanding the hydrologic regime." The detonation apparently increased the permeability of the rocks surrounding the fractured "chimney" created by the detonation more than had been expected, such that an estimated 10 percent of the void space filled with groundwater (Holzer, 1970, p. 693).

Perhaps it was the outpouring of public opposition, the possibility that unacceptable levels of radioactivity would be present in the commercial gas, the concern that groundwater inflow into the void space would negatively affect the economics of gas storage, or any of many other possibilities that stopped the project. Whatever the reason(s), in a letter dated July 5, 1968—only eleven months after receiving the commonwealth's conditional approval—Columbia Gas wrote to Governor Shafer that the company was "undertaking a reevaluation of Project Ketch" and "Columbia is unconditionally withdrawing its (proposal) to conduct the project on a site in the Sproul State Forest." The letter did not go into any further detail regarding the reasons for the company's decision (Pennsylvania Department of Conservation and Natural Resources, Bureau of Forestry, unpublished program files).

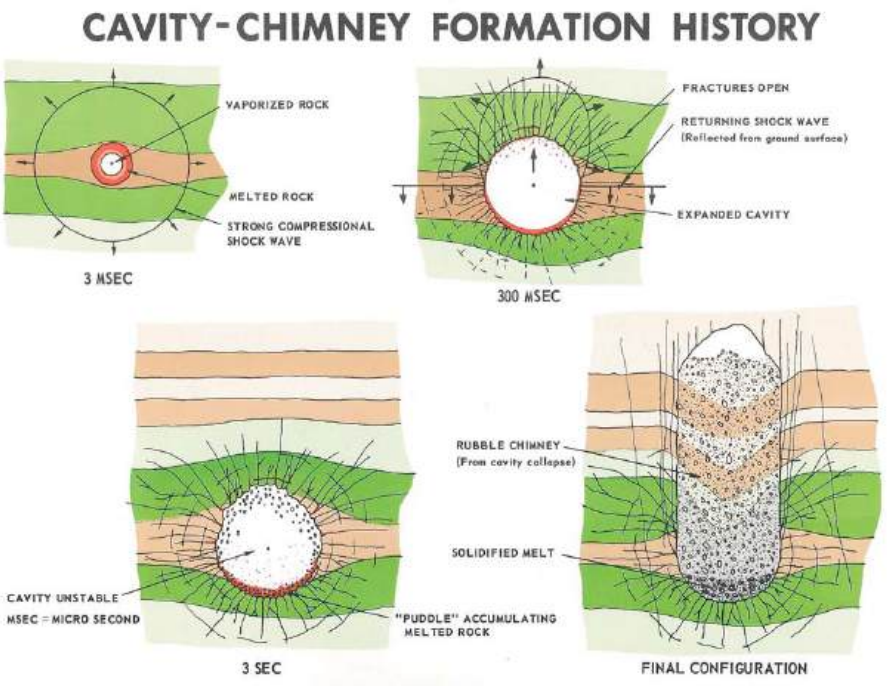


Figure 7. Sequence of figures showing the development of the underground cavity from the nuclear blast (from Forrest and Hague, 1967, Figure 2).

Just as the wind had been let out of the sails of Project Ketch, the *Plowshare* Program itself was soon on the wane. The program effectively ended in May 1973, following its final test in Colorado, and it was no longer funded beyond the federal government's fiscal year ending in 1975, coincident with the dissolution of the Atomic Energy Commission as a result of the Energy Reorganization Act of 1974 (Buck, 1983, p. 18; U.S. Department of Energy [no date], p. 6).

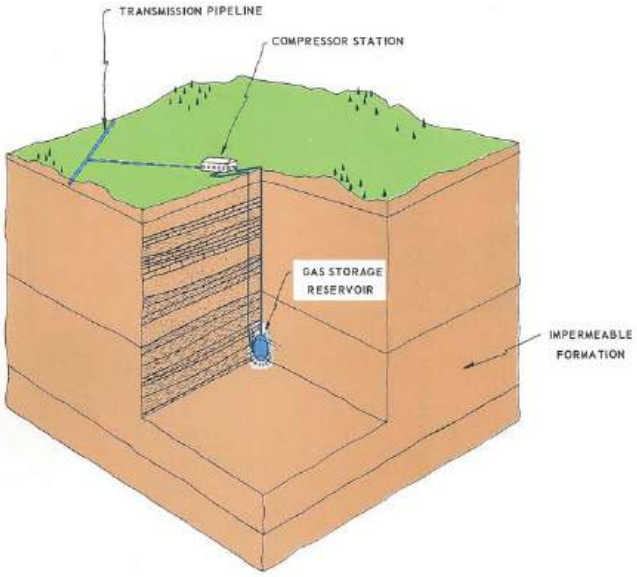


Figure 8. Cutaway section showing the final nuclear gas-storage field (from Forrest and Hague, 1967, Figure 3).

ACKNOWLEDGMENTS

The author would like to thank the Pennsylvania Department of Conservation and Natural Resources, Bureau of Forestry, Minerals Division, for making its files on Project Ketch available for review. Thanks also to Joel O. Lubenau, Emeritus Certified Health Physicist, and David J. Allard, Director, Pennsylvania Bureau of Radiation Protection, for their assistance in the editing and preparation of this article.

ADDITIONAL INFORMATION

Several legacy AEC videos on Project *Plowshare* and some of the specific projects completed within its scope can be found on the Internet (YouTube). Many other *Plowshare* government documents

and other books on the subject can also be quickly found on the Internet. The Pennsylvania State Archives and Pennsylvania State Library also maintain files on Project Ketch.

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"We Have to Remember What's Important in Life—Friends, Waffles, and Work. Or Waffles, Friends, [and] Work. But Work Has to Come Third."

Ellen Davis, Brittany Furlong, Eric Hirschfeld, and Abigail Remis
Summer Interns, Pennsylvania Geological Survey

Figure 1. Summer interns in the Pittsburgh office of the Pennsylvania Geological Survey, left to right: Ellen Davis, Eric Hirschfeld, Abigail Remis, and Brittany Furlong

The Pittsburgh office of the Pennsylvania Geological Survey is located on an island. This makes it slightly inconvenient for anyone to run away and escape daily office duties if for some reason they wanted to do that. Full-time staff includes less than ten hard workers from different backgrounds and educations who, by May, found themselves anxiously awaiting the arrival of the new summer interns (Figure 1). The bureau has ongoing funded projects that allowed us eager interns to join it for what would be an unforgettable four months. We spent 40 hours a week feeling welcome in the workplace and learning more than we could have imagined. By the end of the internship, four very different and independent students assimilated into office life while sharing countless valuable experiences. We even managed to escape the island once or twice.

Our summer coincided perfectly with the final few hectic months of the Appalachian Storage Hub (ASH) project, which was assigned to Ellen and Eric. The ASH research team included members of the state geological surveys in Ohio, Pennsylvania, and West Virginia and was tasked with evaluating potential natural-gas-liquid storage areas. Since the project was coming to a close during our time with the bureau, we fully experienced the officewide impact of deadlines. With only five PETRA® software licenses, work became cutthroat and we often found ourselves fighting to hoard a slot to digitize wells

and create cross sections of geologic intervals. Despite the high tension caused by software glitches and summer vacations, we also managed to hone our petrography skills by analyzing Oriskany sandstone thin sections. We participated in conference calls and Skype meetings, where we learned the importance of the mute button! As the ASH deadline loomed closer, we assisted with data tabulation and compilation as needed. When the report was finished and submitted, we helped prepare for the report's public debut, which we attended at the end of August. ASH provided us with the opportunity to grow professionally while working toward a deadline, and despite the sleep we lost worrying about whether or not we would finish, it was certainly a valuable learning experience.

Abby and Brittany were hired to work on the Midwest Regional Carbon Sequestration Partnership (MRCSP). The objective of this ongoing project is to determine a cost-effective and structurally sound way of mitigating carbon dioxide emissions while increasing natural-gas and oil production. Or, in the vernacular, simultaneously saving the planet and making money. Work began in 2003 (when we were but 8 years old), and by the end of the project, more than 90,000 oil and gas wells will have been evaluated to determine subsurface carbon dioxide storage potential. Characterization work requires the utilization of PETRA®, geologic software used to collect and manipulate well data. Like good tech-savvy Millennials, we quickly learned the ins and outs of the program. Primarily, the software was used to digitize gamma ray and neutron porosity logs. We also used PETRA® to "pick" rock formation tops and bottoms at various depths of well locations, and we correlated them to form cross sections revealing structural trends across the area of interest. Although the tedious work led to occasional catnaps, knowledge of this software is incredibly useful for geologists, and adding these skills to our résumes makes us even more valuable.

Geology cannot be done just sitting at a desk; it is necessary to venture out into the field and get your hands dirty. In June we traveled to Hollywood in Clearfield County for our first out-of-office, off-the-island work experience, and we certainly did get our hands dirty on Sewer Plant Road. We were the first interns to begin the daunting task of cataloging Department of Conservation and Natural Resources' inventory of well cuttings (Figures 2 and 3). Since some boxes were not much more than homes for mice, we checked the depth intervals to ensure that we had the entire sample listed on a 40-page spreadsheet compiled by staff geologist Katherine Schmid. Boxes were relabeled and organized alphabetically by county and ascending API number. This trip was the first of many in an effort to create a facility of samples better organized and more easily accessible. As aspiring scientists, it is important to learn different ways to keep data and samples cataloged and organized. Overall, this trip was not only a professional learning experience, but also an opportunity to learn about interactions with coworkers as we worked alongside our Middletown counterparts. Nonfossil remains were an added bonus (Figure 4).

The work didn't stop with these two major projects. We performed many other tasks during our time at the bureau. The most important contribution we made to the office was the annual intern lunch (Figure 5). Each year, the interns are in charge of the organization and preparation of lunch for the office, and this year we thought of the unique idea of "breakfast for lunch." We brought donuts and set up a waffle bar complete with fruit, chocolate chips, sprinkles, chocolate sauce, and butter and syrup for the less adventurous. Needless to say, the entire office was in a sugar coma by 1:30.

Decorating the display case at the front of the Pittsburgh office is also an intern responsibility, and this year we decided to focus on the heritage geology of Pennsylvania. In Pennsylvania, 101 sites are classified as geologic heritage sites for their value and significance, but out of respect for anyone

Figure 2. "I have no idea what I'm doing, but I know I'm doing it really, really well." (The interns on-site at Hollywood, Pa.)

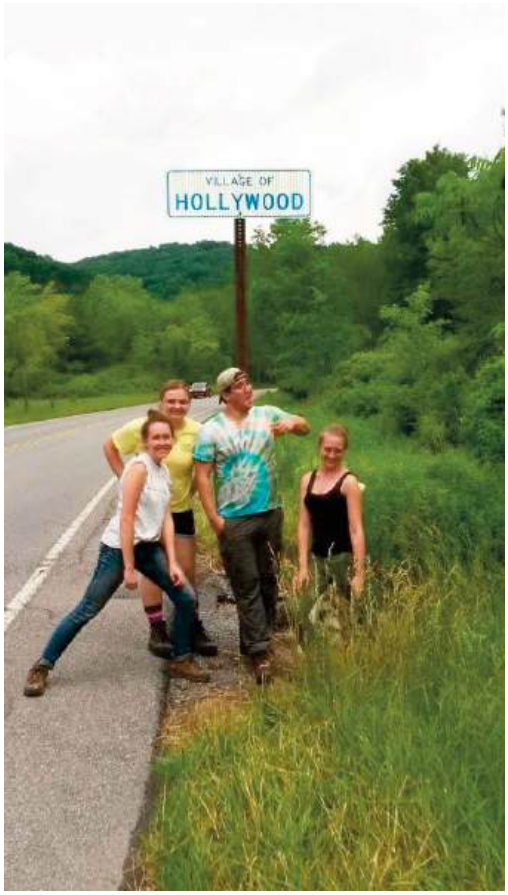

Figure 3. "I have never taken the high road. But I tell other people to 'cause then there's more room for me on the low road." (The interns at Hollywood, Pa.)

Figure 4. "Everything hurts, and I'm dying." (Nonfossil remains in a box at Hollywood, Pa.)

observing the display, each intern selected only one site to research. Our expertly designed display features a whale, a pothole, a waterfall, springs with real rocks, and a precarious rope bridge. It highlights important natural geologic features for educational purposes while promoting an appreciation and conservation of such unique sites. This project gave us the opportunity to work together more than any other assignment this summer, and it was an educational and creative way to leave our mark on 500 Waterfront Drive.

Some people our age spend their summers fetching coffee and being bossed around. Others are "just another intern," unnoticed at a large corporation. Our summer with the bureau was not like other internship experiences (Figure 6). We were warmly welcomed to the rather small office and learned our coworkers' quirks over office lunches. "Make the interns do it!" was hollered with affection, and any bossing around was (usually) accompanied by (mostly) invaluable advice. We are incredibly grateful for the opportunities we received this summer and are hopeful that our legacy remains long after we have left the island.

Disclaimer: The title and the captions in quotation marks are quotes from the hit NBC television show, "Parks and Recreation."

Figure 5. "Why would anyone ever eat anything besides breakfast food?" (The interns supplied breakfast food for lunch.)

Figure 6. "Sometimes you gotta work a little, so you can [play] a lot." (The interns, along with some of the staff in the Pittsburgh office of the Pennsylvania Geological Survey.)

Editorial *(continued from page 2)*

Resource Assessment Project. The division continues its daily work, too, maintaining and enhancing the Exploration and Development Well Information Network (EDWIN). Over the past year, more than 8,000 documents associated with oil and gas wells permitted by the DEP have been added to the system, and staff completed digital entry of nearly 100,000 pieces of reported and interpreted data based on these documents.

Very little of the bureau's work could have been completed without the efforts of the Geologic and Geographic Information Services Division (GGIS). This group touches every map, publication, and data set released or owned by the bureau. GGIS staff supported continued improvements to EDWIN and the development of the new stratigraphic data management system. The latter database went into production in the summer. It now holds our field mapping data and other geologic data tied to points on the earth. Nothing consumed more division resources in 2017 than the development of the bureau's new website. Deployed in August, our site now offers the same look and feel as other recently renovated state government websites.

Bureau staff participated in more than 30 educational and outreach activities, from classroom presentations to programs at state parks to seminars for college groups and professional societies. Staff members gave eight presentations and helped to run field trips at section meetings of the Geological Society of America and the American Association of Petroleum Geologists. As usual, the crown jewel of our outreach activities was the Field Conference of Pennsylvania Geologists. This year, the conference was held in State College, with Penn State as a co-convener and 220 attendees.

We look forward to even more excitement next year. There will be new projects to start, ongoing projects to continue, collections and data to organize, and always a surprise or two around the corner. Stay tuned!

Gale C. Blackmer

Gale C. Blackmer,
State Geologist

BUREAU NEWS

Fossils—Portraits of the Past at Beltzville State Park

Aaron D. Bierly
Pennsylvania Geological Survey

On August 25, 2017, Department of Conservation and Natural Resources (DCNR) staff members Cynthia Kurtek (Beltzville State Park) and Aaron Bierly (Pennsylvania Geological Survey) teamed up for a half-day of prehistoric fun. The public program included a hands-on fossil and rock display bearing several dozen samples from the Precambrian, Paleozoic, Mesozoic, and Cenozoic; a presentation on the fossilization process; fossil-hunting and identification tips; and a field trip to collect samples for the participants to keep (see photographs below, taken by MaryAnn Haladay-Bierly; also see photograph on page 1). The fossils at the collecting site came from a layer of approximately 387 million-year-old rocks from the Mahantango Formation. The sediments that became these rocks were deposited in a moderately shallow, well-oxygenated sea having a large diversity of benthic (bottom-dwelling) invertebrates. Fossils found during the field trip included bivalves (clams), brachiopods, bryozoans, solitary and colonial corals, crinoids (sea lilies), cephalopods, and trilobites.

To learn more about Pennsylvania fossils, and to access the Pennsylvania Geological Survey's publication, *Common Fossils of Pennsylvania,* please visit DCNR's website at www.dcnr.pa.gov/Education/GeologyEducation/IdentifyingandCollecting/Pages/default.aspx.

Drake Day—Let's Rock!

Brian J. Dunst
Pennsylvania Geological Survey

The Friends of Drake Well, Inc., and Drake Well Museum (Titusville, Pa.) host multiple family-oriented events throughout the year. Located at the northern boundary of Oil Creek State Park, the museum invites visitors interested in learning more about the equipment and people involved in the early history of oil production in Pennsylvania. Attractions also include an operating train that can be ridden into the state park.

"Drake Day—Let's Rock!" was held on August 26, 2017. A variety of organizations and volunteers set up exhibits and demonstrations throughout the grounds to enhance the visitors' experiences. And, hey, it's rocks, so what's not to like?

The author with his rock display and demonstration outside the Drake Well Museum.

The Pennsylvania Geological Survey was also represented at the event. Brian Dunst, a Geologist Supervisor in the Pittsburgh office, brought a rock display to the day's festivities. Along with a variety of rock specimens, a demonstration of porosity and permeability provided a picture of those important rock properties.

Visitors to the display ran the gamut from preschool-aged children and their parents, to teachers, professors, and retired drillers and spouses from multiple states. A geophysical log provided perspective, illustrating subsurface geology below the park area down to the basement rocks nearly 8,000 feet below. Guests could walk along the log and "see" the rocks get older.

Drake Day was successful at multiple levels. Northwestern Pennsylvania weather was mild and sunny. Visitors had the opportunity to learn about the Drake Well and see early oil-production equipment. Volunteers enjoyed the exchange of information and the chance to learn something new.

From the Stacks . . .

Jody Smale, Librarian
Pennsylvania Geological Survey

ONLINE SEARCH FOR BUREAU LIBRARY PUBLICATIONS

Have you ever wondered if the bureau library has a book, journal, or map for which you are looking? You can search the State Library of Pennsylvania online catalog to view the holdings of not only the State Library of Pennsylvania, but also the holdings of other state agencies' libraries, including those of the bureau library. Here are some tips for searching the online catalog and for finding items owned by the bureau library.

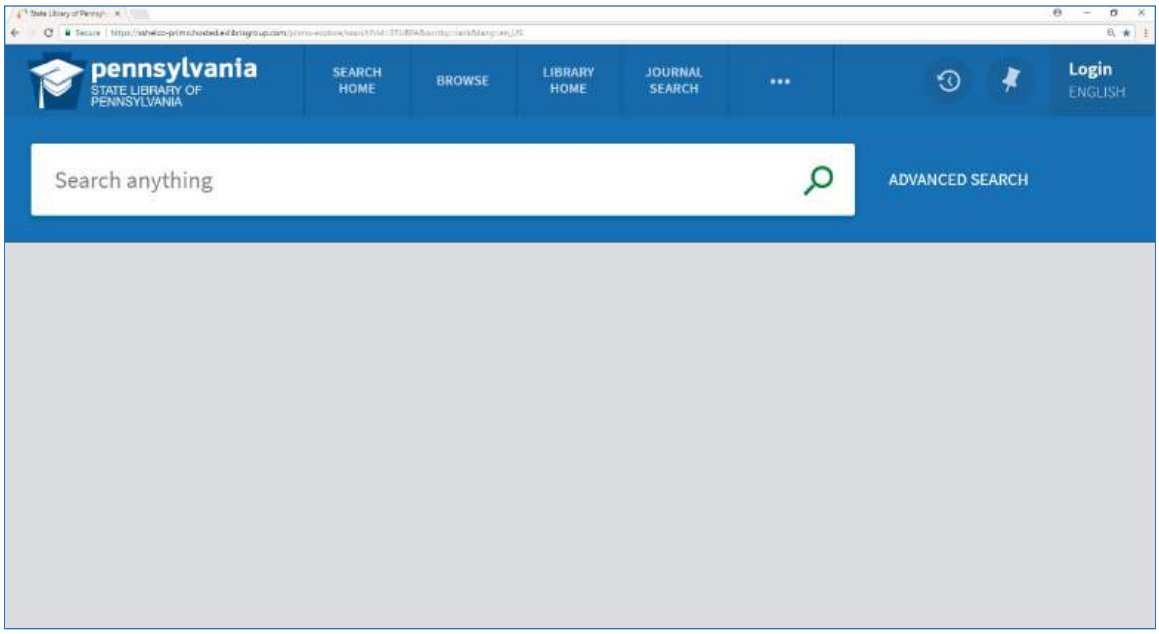

Figure 1. The "Simple Search" box in the State Library online catalog.

You can start your search by using either the Simple Search (Figure 1) or Advanced Search option. With the Simple Search, you can enter words in the "Search anything" box, and they will be searched for across all fields (title, author, subject, etc.). For example, entering the word "paleontology" will produce a list of all the holdings with the word "paleontology" in the title, as well as all the holdings with the word "paleontology" in the subject. As you can see, using the Simple Search can produce a lengthy list of results, depending on the search terms you use, as shown in Figure 2.

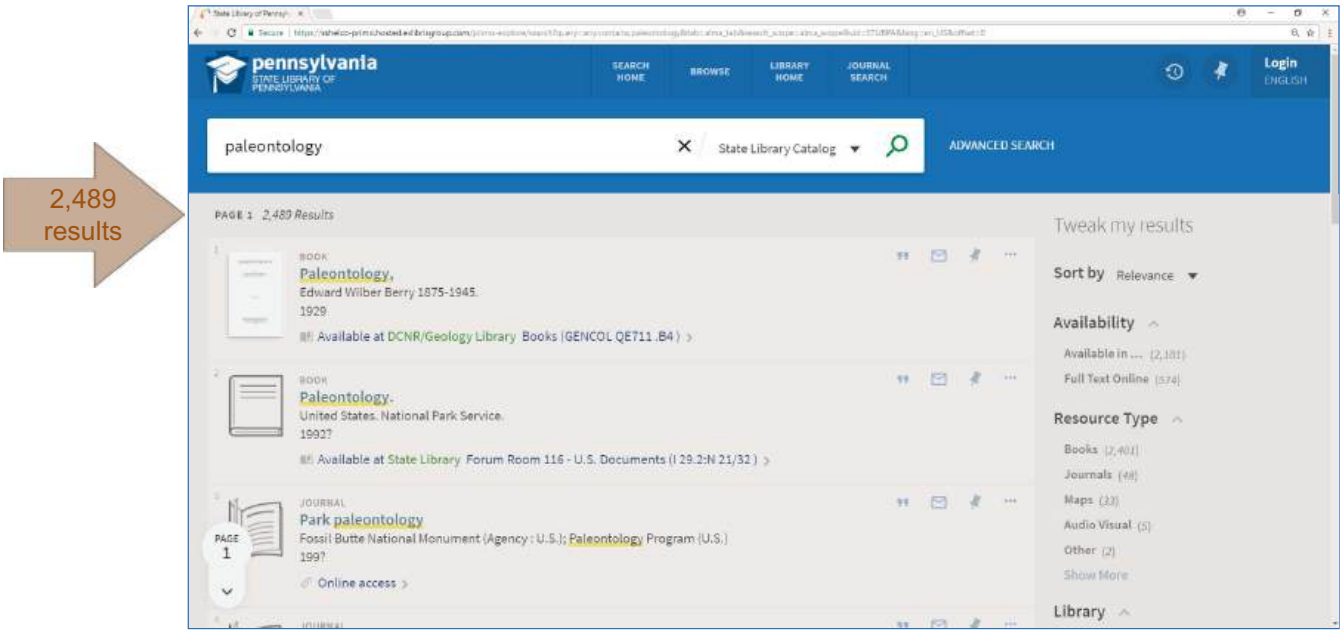

Figure 2. Results from entering the word "paleontology" into the Simple Search box.

By selecting the "Advanced Search" option, you can limit your search for words specifically in the title, author/creator, and/or subject fields. With the Advanced Search option, you can also refine your search by material type, language, and publication date.

Using the Advanced Search option to search the State Library catalog for the subject "trilobites" produces 41 results. To limit the results to those items found only in the bureau's library, select "DCNR/Geology Library" under the "Library" heading on the right-hand side of the screen, as shown in Figure 3.

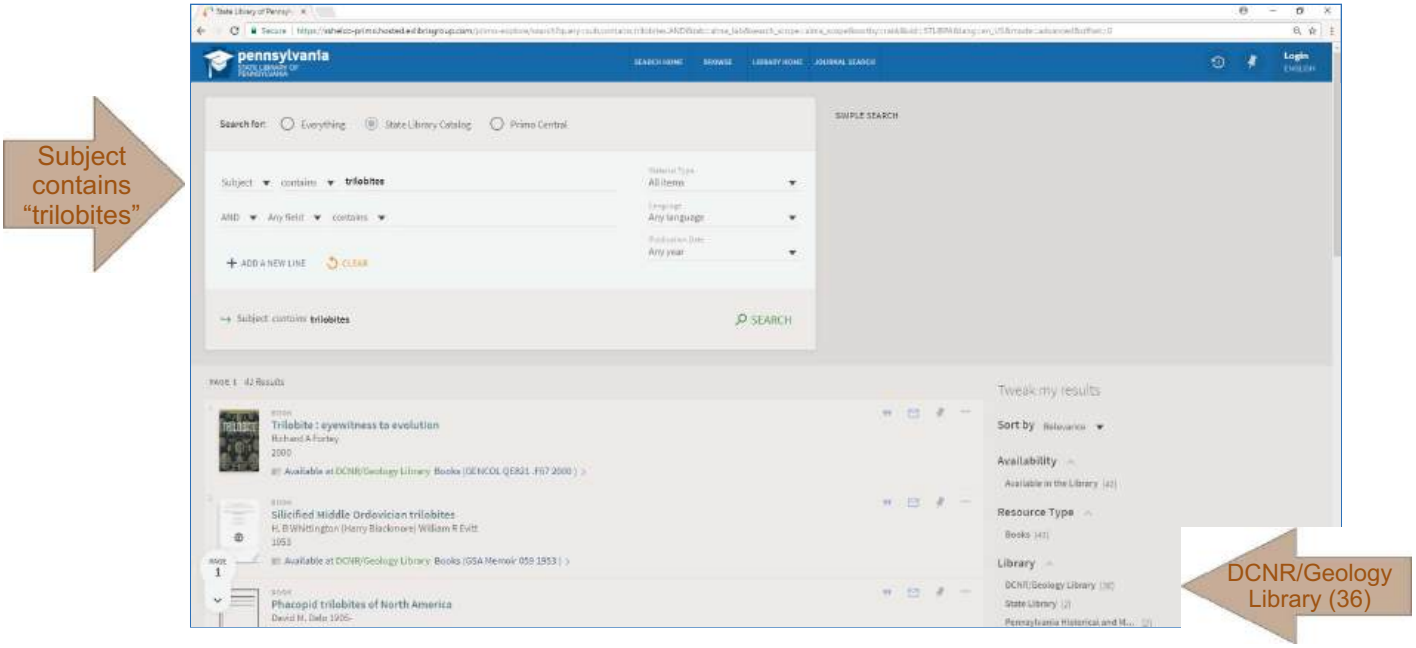

Figure 3. Results from entering the word "trilobite" and selecting "Subject" in the Advanced Search box. The results were further refined by selecting DCNR/Geology Library.

When you find a publication you are interested in viewing, select the title to see whether it is available or on loan from the library (Figure 4). If the item has been loaned, the date the item is due back to the library is displayed.

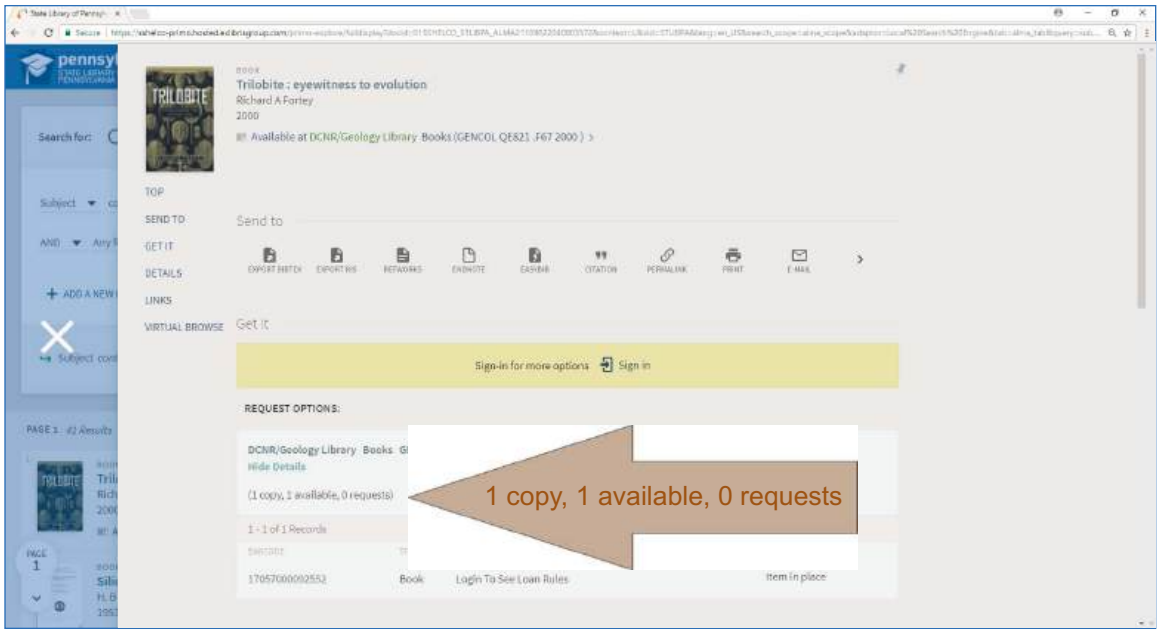

Figure 4. Results from selecting a title, showing whether it is available or on loan. If it is on loan, the date it is due back is displayed.

These are just a few tips to familiarize you with the online catalog. If you are looking for a publication and cannot locate it in the catalog, please contact the library for assistance.

RECENT ADDITIONS TO THE BUREAU LIBRARY'S COLLECTION

- *Extinction—How life on earth nearly ended 250 million years ago*, by Douglas H. Erwin, Princeton University Press, 2015.
- *Global environment—Water, air, and geochemical cycles* (2nd edition), by Elizabeth Kay Berner and Robert A. Berner, Princeton University Press, 2012.
- *The Hummelstown brownstone industry—A community heritage*, by Ben F. Olena, Hummelstown Area Historical Society, 2016.
- *Paleoclimate*, by Michael L. Bender, Princeton University Press, 2013.
- *Petrochronology—Methods and applications*, edited by Matthew J. Kohn, Martin Engi, and Pierre Lanari, Mineralogical Society of America Reviews in Mineralogy and Geochemistry, v. 83, 2017.

A Look Back in Time

Sam Root (a former staff member at the Pennsylvania Geological Survey) took this photograph in September 1972 of pinnacles developed on Rockdale Run Formation limestone outside of a school in Shiremanstown, Cumberland County. If you look closely, it appears that a monstrous creature is emerging from the earth!

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

RECENT PUBLICATIONS

Atlas Report **(November 2017)**

- Bedrock geology of the Mingoville quadrangle, Centre County, Pennsylvania

Open-File Miscellaneous Investigations **(October 2017)**

- Water depth of Hopewell Lake and Scotts Run Lake—French Creek State Park, Berks County, Pennsylvania
- Water depth of Black Moshannon Lake—Black Moshannon State Park, Centre County, Pennsylvania
- Water depth of Lake Marburg—Codorus State Park, York County, Pennsylvania
- Water depth of Lackawanna Lake—Lackawanna State Park, Lackawanna 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.

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 CorelDraw (v. 9 or above) or Adobe Illustrator (v. 8 or above) files.

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.

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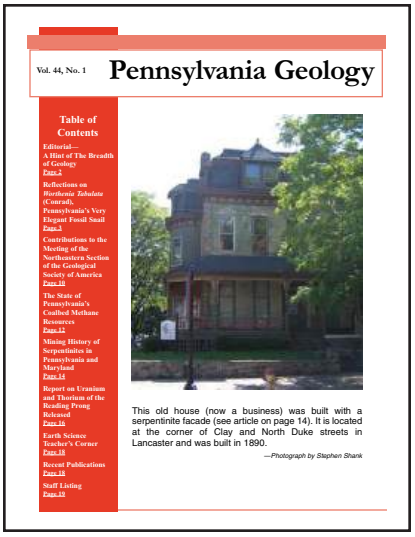
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This old house (now a business) was built with a serpentinite facade (see article on page 14). It is located at the corner of Clay and North Duke streets in Lancaster and was built in 1890.

—Photograph by Stephen Shank

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