CONTENTS

All is culm ................................................................................................ 1
Coal recovery from mining and processing wastes ..................................... 2
PAMAP—Progress toward a digital base map ......................................... 12
New releases ........................................................................................... 14
New open-file reports available online ................................................. 14
New edition of Map 10 ......................................................................... 16
Meet the staff—Part 4 .............................................................................. 16
Fond farewells ......................................................................................... 19

ON THE COVER

A variety of equipment that is used by the Hazleton Shaft Corporation in its effort to recover additional anthracite coal from the culm banks left behind by previous mining efforts (see article on page 2). Photograph by George E. W. Love.

PENNSYLVANIA GEOLOGY

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

VOL. 37, NO. 2 SUMMER 2007
STATE GEOLOGIST’S EDITORIAL

All is Culm

The old adage “waste not, want not” is true. If we reuse as much as we can and find a use for waste, we will be better stewards of the earth. One person’s waste is another’s raw material. During the first half of the last century, my wife’s grandfather made his money in mushrooms. For many years people just could not get rid of all the horse manure piling up on city streets. He turned that one waste into the substrate for a cash crop. My grandparents spent 40-some years in Brazil, where every item came in by horseback or over a long dirt road on questionable trucks. My grandmother once admonished me for cutting off too much of the end of a stalk of celery because it was wasteful. I had never placed a high value on celery and so treated it in a cavalier fashion.

Here in Pennsylvania, my town hands out large paper bags for leaf disposal in the fall. I have chosen not to use them. Instead, I take delight in my compost pile. Everything that goes into the compost is a result of sunlight, carbon, and minerals distinctive to the Stonehenge Formation, on which I live. To me, nothing is better than seeing all those grass clippings, leaves, and rotten tomatoes turning into good soil for my garden.

In this issue, you will read about harvesting coal from waste piles called culm. When I was in college, my professors said that today’s waste is tomorrow’s ore body. The idea was that a landfill is, in a way, a concentration of all the objects we use in civilization, and in the future people will “mine” landfills for valuable metals and other substances. The same is true of coal. The low quality material (waste) from another era is a valuable material today. It turns out that we can’t afford to throw away the end of the celery.

Jay B. Parrish
State Geologist
Coal Recovery from Mining and Processing Wastes

by George E. W. Love
Bureau of Topographic and Geologic Survey

INTRODUCTION. Mining of the anthracite coal seams of Pennsylvania began more than 170 years ago. The tragedies of mining life and death have been recounted in numerous publications and were the impetus for the 1969 movie, The Molly Maguires. Hazleton, Pa., where the Hazleton Coal Company was incorporated in 1836, was among the early mining camps (Inners, 2007). One mine, the Hazleton Shaft, began operation in 1898 and operated continuously for 57 years. After closure of the mine in 1955, the Hazleton Shaft Breaker, the coal processing facility associated with the mine, continued to operate for another 28 years. In the year 2000, like the mythical phoenix, anthracite “mining” at the Hazleton Shaft arose again from its ashes, or, rather, its culm banks. Changed economic circumstances and improved technology have combined to result in jobs and company profit, and ultimately the return of a scarred landscape to a more environmentally benevolent landform. In 2000, Inners, Lentz, and Roskos wrote a wonderfully descriptive technical paper about this culm recovery system. The present paper revisits the process, and the activities required to turn a colossal eyesore into a valuable fuel source will be described. These activities include evaluating, mining, and beneficiating (processing into a salable product) the culm, and ultimately profiting from the process.

HAZLETON SHAFT CORPORATION. Starting and operating the Hazleton Shaft Corporation (HSC) required a blend of technical expertise, financial expertise, luck, entrepreneurial spirit, and chutzpah. We will focus on the technical expertise.

Technical expertise includes a clear understanding of the characteristics of the ore body (exploration); the means to physically separate the ore from the material that is not ore (mining); the subsequent means to separate the ore into its component parts (beneficiation); the ability to handle the component parts (storage and/or disposal); and the restoration of the property to an acceptable condition (reclamation).

1Modified from Love (2007).
THE “ORE” BODY. The term “ore” is generally applied to natural associations, usually of metalliferous minerals, from which some desirable material can be extracted profitably. The residue from anthracite mining is hardly a natural association, is certainly not metalliferous, and has never been a mineral, but it can, if wisely approached, yield a desirable material profitably extracted. The ore body in the current assessment is the waste produced from historic mining and processing of the anthracite brought to the surface by the miners; we know it as culm.

Culm is composed of rock, wood, metal, coal, and any other material discarded by past operators. HSC’s predecessors have conducted a number of assessments of the culm since the last recovery efforts (Inners, Lentz, and Roskos, 2000, p. 6). These assessments include surveys of the size and configuration of the culm banks to determine volume and density, collecting physical samples for the performance of metallurgical studies to project how much coal is present and by what means it can be separated from the undesirable portions of the ore body, and determining the potential quality of the products. HSC conducted its own studies in the late 1990s and based its economic projections on a combination of all the assessments. It concluded that there are probably 19 million cubic yards of culm containing 5 percent coal by weight. That means that for each 100 tons processed through the plant, 5 tons of salable product might be recovered.

Determining the tons of ore available means deciding what density to use for the in-place materials in any calculations. This can be a daunting task. Suppose you needed duck feathers for the manufacture of ladies’ hats. You buy your feathers from Dr. Jon Inners, who is selling blended materials by weight. Imagine trying to decide the average weight of a material whose true blend is unknown, but whose constituents include wooden matchsticks, glass marbles, all the feathers from a small flock of green ducks, feathers from one large black anhinga, and a few 16-pound bowling balls! Since the green feathers are the commodity of value, the weight per green feather and the weight per unit volume are critical data. After due deliberation you determine (guess?) that the feathers represent 0.1 percent by weight of each 33-pound cubic foot, the green feathers weigh 10 grams each, and the anhinga feathers weigh 15 grams each. Anhinga feathers are 0.01 percent of all feathers by physical count (as best you can tell). Risk taker that you are, you bid the equivalent of 1 cent per cubic foot (the ore body is 50 acres averaging 75 feet deep), and win the bid. Congratulations; you now own 6.05 million cubic yards of ore body and are in debt to the tune of $1.63 million. Dr. Inners plans to retire!
Separating the desirable material from the waste, known as beneficitation, is the next significant challenge in processing culm. Removal of unwanted constituents to improve the quality of the salable product involves knowledge of particle size, shape, density, surface chemistry, and so on. Let us look at a few of the problems with our imaginary blend. You can use a screen to separate out the bowling balls, a low-cost procedure at no loss of feathers (if the feathers are dry and the bowling balls are not sticky). High-velocity air—more expensive than screens—will blow all the feathers and matchsticks out of the remaining mix so that the marbles are gone. Low-velocity air will separate the matchsticks from the feathers due to density and “particle shape” differences. Finally, since we assumed (correctly!) that 0.1 percent of the weight of the ore body was feathers, and we were good at beneficitation, we now have recovered 100 percent of the contained feathers at a beneficitation cost of 12 cents per feather. Of course, the green feathers are the commodity, and the black feathers are contaminants. Now, from the marketing side, if the 100-pound bag product is not at least 99.9 percent “pure,” that is, green feathers by weight, you must reimburse the customer $5.00 for each tenth of a point or portion thereof below 99.9 percent green feathers. So, if we recovered 100 percent of the feathers, but each bag contains 0.15 percent black feathers by weight, have we made any money if a bag sells for $500? Would you/should you spend additional money to beneficiate the final feather product to remove the black feathers? (Dr. Inners has patented a process that differentiates the feathers based on the fact that duck feathers float in water while anhinga feathers sink—yours to license for $63.28 per bag of feathers.) Do you think women will continue to wear hats? Should you have put your money in a passbook saving account? Welcome to the economic facts of mining.

Once the studies were completed, HSC accepted the challenge and has spent millions of dollars in anticipation of building and operating a profitable facility. HSC believed that previous efforts to recover coal were not as efficient as they could be today.

MINING. Mining, broadly speaking, is the science, technique, and business of mineral discovery and exploitation (Thrush, 1968). Coal is not a mineral, but the principles of mining still apply. Mining historically has evoked images of men emerging from dark openings in the earth, soiled masks framing dark and vacant eyes, stooped and exhausted. The loss of limbs, and sometimes of lives, was not uncommon. The skilled use of the hammer, hand drill, pickax, and shovel was the ticket to employment. Production was frequently less than 1 ton
of material extracted or processed per miner for each hour worked. This is a common measure, similar to miles per hour, and is known as tons per man-hour (tph).

Today, the HSC miner sits comfortably in his control cab, driver’s cab, or control room, using his hands only to guide a hydraulic or electric behemoth that allows the company’s production to be measured in tens, if not hundreds, of units per man-hour. The rate and quality of the product is, in most cases, controlled by hydraulic or electronic devices designed to monitor speed, density, size, and grade.

In mining parlance, the run-of-mine (ROM) (raw material) is excavated from the mining area using rubber-tired loaders. A 100-ton Caterpillar 992 loader capable of excavating up to 15 cubic yards of culm at a single bite easily lifts its 20-ton load, backs into position, and dumps the culm into a waiting truck. Should the “Cat” be out of service or undergoing preventive maintenance, its slightly smaller associate, an 85-ton Michigan 475 loader with a 12-cubic yard bite, moves into action.

Regardless of which loader is operating, the truck, an off-road hauler, waits for the loader to dump 4 to 5 buckets into its back. (Culm weighs considerably less per unit volume—100 to 110 pounds per cubic foot—than many other mined materials.) The haulers, a mixed fleet of Terex and Euclid 75- to 85-ton trucks (tons in the payload), carry the culm to the processing area.

Depending on the distance from the active mining face(s), each loader will feed from 2 to 4 trucks (Figure 1). The idea is to minimize the time the loader, the key piece of production equipment, is sitting idle waiting for a truck to return. For example, if it takes 40 seconds to complete the loading cycle and the truck carries 6 bucketsful of culm, it will take 240 seconds, or 4 minutes, to load the truck. In the loading cycle, the loader crowds (pushes) into the culm bank, stops, backs up while raising the bucket to the tramming (hauling) position, stops, then moves forward to the truck while raising the bucket higher, stops and dumps the load, and backs up while lowering the bucket into the crowd position. Then, if the truck must travel 1,500 feet and has an average loaded velocity of 12 miles per hour (about 18 feet per second), the trip will require slightly more than 85 seconds. Add another 40 seconds to position and dump the load, which depends upon the truck traffic, physical circumstances surrounding the crusher, the crusher size and configuration, and so on. The return trip, when the truck is empty and probably moving downslope, might be completed at an average of 15 miles per hour (22 feet per second), requiring another 60 seconds. Finally, add another 60 seconds to maneuver the
truck into loading position, and the total truck load-haul-dump-return cycle is 485 seconds, or just over 8 minutes. In summary, if a loader can comfortably load a truck in 4 minutes, and it takes 8 minutes per truck from the time it is ready to load until it is again ready to load, two trucks will minimize the waiting time for both the loader and the truck operators. Of course, this works only if the loader can easily break the culm out of the working face, if the loading area is dry and the traction is good, if there is never spillage, if the equipment never breaks down mid-cycle, and so on.

In this case, the total culm moved to the plant during an 8-hour shift operating at an effective 50 minutes per hour (83 percent efficiency) with a Cat 992 loader would be approximately 958 tons. With the smaller Michigan 475 loader, that hourly rate drops to 882 tons. Clearly, the mix of equipment can affect the production rates and therefore the economics of an operation. The same three people are required in both situations, but productivity drops 8 percent.

The operation does not just involve moving culm to the plant. In many cases, the spot where the culm is mined must be prepared. Roads must be built and routinely graded; safe mining benches developed (the open, generally flat areas where the trucks are positioned and the loaders maneuver); and waste areas identified. Additional equipment and manpower are required. In addition to the big loaders and trucks mentioned above, HSC’s equipment fleet includes bull-

---

Figure 1. An active mining area (mining face). The truck driver is waiting for the supervisor to leave so he can position the truck for loading. Raw culm is visible in the immediate foreground.
dozers, excavators, smaller utility loaders, a motor grader, various support vehicles, and four draglines.

Draglines are versatile pieces of earthmoving equipment (having low operating cost) capable of reaching over substantial distances, digging far below their operating platforms, and dumping well above their platforms. The dragline fleet includes a crawler-mounted 3500 Manitowoc with a 3.5-cubic-yard bucket; a crawler-mounted Lima 2400 with an 8-cubic-yard bucket; two Bucyrus Erie 9W walking draglines with 10-cubic-yard buckets; and one Marion 7400 walking dragline with a 15-cubic-yard bucket (Figure 2). Walking draglines do, in fact, walk, but not too quickly. The 9W, for example, takes two 7-foot 6-inch steps each minute—a whopping 0.15 mile per hour.

HSC has used its draglines to open mining areas more quickly and at lower cost than could be done using loaders and trucks. For example, the truck-loader setup discussed above moved approximately 900 tons per hour using three people on a prepared surface over maintained roads. A 9W dragline sitting on a prepared pad can move 17 to 25 tons 300 feet horizontally by 150 feet vertically in less than one minute.

Using the same effective 50 minutes per hour, the 9W dragline moves 1,050 tph versus the 300 tph for the trucks and loader. The Marion dragline, a bigger digger, moves more material farther because its bucket is larger and its boom is longer. Of course, things are not this simple, but the proper application of equipment types makes the most efficient operation, which translates into making a profit.

Figure 2. A Marion dragline in operation.
PROCESSING THE CULM. Once the culm arrives in the process area, the terminology changes. The culm is “raw feed” that must be transformed into “prepared feed.” The first step is to dump the raw feed onto a scalping screen that removes (scalps) the material greater than 6 inches (plus 6 inches) in all dimensions (Figure 3). This plus-6-inch material passes onto a picking table where the last truly manual job is performed—a person picks (removes) the large rocks, pieces of wood (trees, planks, or mine roof supports), metal, and other objects. The material passing the inspector is sent to a 27-inch by 42-inch jaw crusher; the hole through which the feed passes is 27 by 42 inches. This means that the crusher will accept any object that will fit through a rectangular opening of that size. As the object moves downward, it is compressed by a moving jaw that closes the 42-inch dimension to some smaller setting—in this case, 6 inches. Matter remains in the jaw until it can fall through the smaller opening at the bottom. Raw feed is also stockpiled near the scalper, to be used on the second shift. It is taken from the open stockpile and dumped onto the scalper by a loader.

All material smaller than 6 inches in at least one dimension (minus-6-inch material) passes onto a conveyor belt that either transports it to an open stockpile or to the 100-ton prepared feed surge bin (feed bin). An electromagnet hangs over the belt to remove any tramp (un-
wanted) metal before it arrives at either destination. Tramp metal could damage the downstream processing equipment. The open stockpile of prepared feed is a common practice. It will be used during the second shift (3 p.m. to 11 p.m.) to supply feed to the beneficiation plant in the event the scalper is inoperable or down for maintenance.

The feed is “metered” out of the feed bin by a vibrating feeder. This device controls the rate of material going into the next step of the process. Rate of feed is very important to avoid overwhelming the downstream equipment, which can result in either poor quality or poor recovery. Poor quality translates directly into lost customers; poor recovery translates directly into lost value.

**BENEFICIATION OF PREPARED FEED.** The prepared feed—the rock, wood, coal, and any other material that passed through the scalper, through the jaw crusher, past the picking table and under the magnet—begins its journey through the beneficiation portion of the operation (Figure 4). Depending on the head grade and operating conditions in the plant, the prepared feed enters the plant at 250 to 350 tph. Head grade means the contained coal values per unit; more coal means higher starting values and lower contained waste. The rate is monitored using a conveyor belt scale but is determined by the plant operator, whose function is to ensure that the coal recovery target is met, the coal quality target is met, and the fewest dollars are spent.

![Figure 4. Processing plant. From PAMAP image 30002460PAN.](image)
The prepared feed flows across an 8-foot by 20-foot vibrating screen that separates the stream into a fraction whose particles are between 0.5 inch and 6 inches in size (the minus-6-inch by plus-0.5-inch fraction), and a fraction whose particles are smaller than 0.5 inch (the minus-0.5-inch by 0-inch fraction). The latter includes clay-sized particles of rock, coal, and whatever else was in the culm. Breaking the feed stream into parts by size is a proven approach to maximize recovery and minimize costs.

The minus-6-inch by plus-0.5-inch (coarse) fraction goes into a coarse primary heavy-medium circuit, which separates the material on the basis of specific gravity (SG). “Primary” means that this is the first step in the flotation portion of the multiphase process. The medium, a mixture of water and magnetite, has an apparent SG of 2.0. This means that anything with a larger SG, such as rock, sinks; it is then washed to recover the magnetite and is piled outside the plant for removal to the reclamation area. The lighter materials, such as coal, float. The heavy-medium circuit is a Wemco Drum, a subhorizontal rotating drum that discharges the float to a double-deck screen. The screens are sized to separate the float material into various fractions depending on the products needed. The largest size, larger than the top screen, is crushed and recirculated until it passes through the top screen.

Once the float material leaves the coarse primary heavy-medium circuit section, it passes into the secondary (the second step) heavy-medium circuit where the SG separation is set at about 1.6. This is approximate because the SG here is varied depending on the quality of the incoming feed or the required product. The material that floats at the lower SG is standard anthracite coal. Since it can be marketed for a premium price if properly sized, it is conveyed to the sizing section of the plant where it is screened into a variety of products with quaint organic names such as nut, pea, barley, and rice. The products are sold into residential, commercial and industrial markets. The material that sinks, whose SG is between 2.0 and 1.6, contains sufficient British thermal unit (Btu) values that it is marketed as power-plant fuel.

Returning to the minus-0.5-inch by 0-inch (fine) fraction that passed through the vibrating screen, this material is transported to the fine primary heavy-medium circuit. The same 2.0 SG is used to float the higher carbon matter away from the heavier waste. The float goes directly to the secondary heavy-medium circuit. There is no need at this point to separately float the coarse and fine materials. The “sinks” from the fine primary circuit go to a “desliming” screen (a 28-mesh screen) that separates the solids greater than about 0.02 inches in diameter.
from the very small solids and water. The minus-28-mesh “slimes” and water go to a thickener where the water is recovered for reuse and the solids go to disposal in the mine cuts. The minus-0.5-inch through plus-28-mesh solids also go to the refuse pile.

THE OPERATING SHIFTS AND STAFF. Investments in the mining industry are significant, running into multimillions of dollars. HSC is no exception. To derive an acceptable rate of return, not only is the quantity of dollars important, but the timing of the stream of dollars impacts the net present value of the project. Based on principles of financial modeling, “money sooner” is of greater value than “money later.” This translates into employing the working assets for as many hours per day as practical.

HSC regularly works three 8-hour shifts, Monday through Friday, and half a shift on Saturday. The first shift operates from 7 a.m. to 3 p.m. and includes the mining personnel (operators of bulldozers, draglines, loaders, trucks, etc.), the plant personnel (crusher operator, gravity plant operator [the heavy-medium circuits], sizing section operator, and a utility person), maintenance mechanics for the mining equipment, a shift supervisor, and sales and office personnel. As HSC has backup “rolling stock,” the loaders, trucks, bulldozers, and so on, mining equipment maintenance is done on the day shift.

The second shift, 3 p.m. to 11 p.m., usually includes plant personnel and a supervisor only, unless there is a need for maintenance personnel or additional tonnage from the mine, daylight permitting. The stockpiles of culm near the scalper and the prepared feed near the feed bin are designed to carry the plant through the second shift. That is how a well-run operation makes efficient use of its resources.

The third shift, 11 p.m. to 7 a.m., is used for maintenance on the plant. This shift is composed of mechanical and electrical maintenance personnel and a supervisor.

Saturday’s half shift is staffed for 4 hours by the first shift plant crew and for 4 hours by the second shift plant crew. If additional production is needed, additional working shifts can be scheduled.

CONCLUSION. HSC processes about 1,000,000 tons of culm per year to produce 50,000 tons of salable products. Jobs have been created, money is returned to the community, and HSC’s efforts will result in reclamation of a barren landscape. Indeed, the anthracite phoenix has risen again.

ACKNOWLEDGMENTS. The author is indebted to a number of people who have made critical comments regarding the text, both its or-
ganization and clarity. Two persons, Jon Inners (retired from the Survey) and George Roskos (President of HSC), were of immense help.

REFERENCES

Inners, J. D., 2007, Historical chronology of the mining industry in the Eastern Middle Anthracite field and nearby areas, Appendix C, in Inners, J. D., and others, From the “Upper Grand” to the “Mountain City” and the “Top of the 80’s”: Hazleton, Pa., National Association of Geology Teachers, Eastern Section, Field Trip Guide, p. 72–81.


PAMAP—Progress Toward a Digital Base Map

by Helen L. Delano
Bureau of Topographic and Geologic Survey

GOOD NEWS! As part of the PAMAP program, the first round of high-resolution orthophotography (digital aerial photographs whose distortions have been removed) has been obtained for all of Pennsylvania, and the collection of LiDAR elevation data is well along. The orthophotography is available for viewing at www.pamap.info/viewer, and data may be downloaded for use with Geographic Information System (GIS) software from the Pennsylvania Spatial Data Access (PASDA) web site at www.pasda.psu.edu. PAMAP is Pennsylvania’s part of the National Map program, and the data collected for PAMAP will be used to build a digital base map of the commonwealth. Our bureau has cooperated with the U.S. Geological Survey (USGS) to produce paper topographic maps since 1899, but those maps are no longer being updated and printed by the USGS. The digital base map will eventually combine seamless high-resolution aerial photography with ele-
vation data and layers showing roads, lakes and streams, buildings, political boundaries, and other vector data.

ORTHOPHOTOGRAPHY. Each year, about one third of the state is flown for orthoimages (see back cover). The 2007 orthophotography will replace imagery from 2003 and 2004 and is the first repeat collection in the program. This imagery will be available in early 2008. For five counties in southeastern Pennsylvania (2005D), the initial collection of orthophotography in 2005 had a different funding source, and the data should be available on the PASDA site late in 2007.

PAMAP orthophotography is in “true color” and has a 1-foot pixel resolution. It is flown in the spring under leaf-off conditions to maximize ground visibility. It is intended to be viewed at a scale of 1:2,400 (1 inch to 200 feet), and although you can zoom in, positional accuracy may suffer a bit.

LIDAR. LiDAR (Light Detection and Ranging) is a laser-light method of measuring distance and elevation from aircraft. It can provide high-resolution data on ground elevation, vegetation cover, and buildings. The PAMAP LiDAR collection meets federal flood insurance mapping specifications. Currently, approximately 60 percent of the state has LiDAR coverage (Figure 1). The raw data will be processed to provide 2-foot contours, a digital elevation model, and a LiDAR data exchange file with all signal returns. A beta test version of 2006 LiDAR data is available to interested users at http://ceiwin4.cei.psu.edu/Lidar/. After quality assurance testing is complete, the LiDAR data will also be freely distributed.

PAMAP. One of the essential characteristics of PAMAP is that it is not itself a map, but an ever-changing collection of data from which maps can be made. PAMAP is designed to provide the base layers so that, with digital technologies, researchers can use the best, most appropriate data available to add or delete feature layers as they desire, changing scales, resolutions, projections, and so on to meet their needs. The total package of PAMAP products will provide the most up-to-date mapping coverage in the history of the commonwealth.

Support for PAMAP is widespread. Funding comes primarily from the Pennsylvania Department of Conservation and Natural Resources, as well as from the Pennsylvania Office of Administration and Departments of Health, Community and Economic Development, Transportation, and Environmental Protection, and both the Federal and Pennsylvania Emergency Management Agencies. The USGS also participates, contributing funds and administrative support. Partnerships with county governments are an important PAMAP component,
as we anticipate that counties will be providing data layers containing information for roads, buildings, and so on that they already collect and use. More details and updates are available at the PAMAP web site at http://www.dcnr.state.pa.us/topogeo/pamap.

Figure 1. Status of PAMAP LiDAR data as of July 2007. The 2006 data are now available for beta testing; the 2007 data will be available in 2008. F, flown and processed in conjunction with the Federal Emergency Management Agency in 2007.

NEW RELEASES

New Open-File Reports Available Online

The Bureau of Topographic and Geologic Survey recently released eighteen online open-file reports in the surficial map series for quadrangles in northeastern Pennsylvania. These studies were funded by the STATEMAP component of the U.S. Geological Survey’s National Cooperative Geologic Mapping Program. Authored by Duane D. Braun of Bloomsburg University, each report includes
one 1:24,000-scale, full-color, surficial geologic map, text, and data tables. The maps are presented in portable document format (PDF). Relevant geographic-information-system (GIS) data and ArcMap documents are also provided as separate downloads. All of the reports are available on the Survey’s web site at www.dcnr.state.pa.us/topogeo/openfile/ofloc.aspx.

### RECENT SURFICIAL GEOLOGY REPORTS
by Duane D. Braun, Bloomsburg University

<table>
<thead>
<tr>
<th>OFSM</th>
<th>Title</th>
<th>Counties</th>
</tr>
</thead>
<tbody>
<tr>
<td>06–14.0</td>
<td>Surficial geology of the Tunkhannock 7.5-minute quadrangle, Wyoming County.</td>
<td></td>
</tr>
<tr>
<td>06–15.0</td>
<td>Surficial geology of the Factoryville 7.5-minute quadrangle, Wyoming and Lackawanna Counties.</td>
<td></td>
</tr>
<tr>
<td>06–16.1</td>
<td>Surficial geology of the Pittston 7.5-minute quadrangle, Luzerne and Lackawanna Counties (revised April 2007).</td>
<td></td>
</tr>
<tr>
<td>06–17.0</td>
<td>Surficial geology of the Springville 7.5-minute quadrangle, Susquehanna and Wyoming Counties.</td>
<td></td>
</tr>
<tr>
<td>06–18.0</td>
<td>Surficial geology of the Hop Bottom 7.5-minute quadrangle, Susquehanna and Wyoming Counties.</td>
<td></td>
</tr>
<tr>
<td>07–01.0</td>
<td>Surficial geology of the Dalton 7.5-minute quadrangle, Lackawanna and Wyoming Counties.</td>
<td></td>
</tr>
<tr>
<td>07–02.0</td>
<td>Surficial geology of the Lopez 7.5-minute quadrangle, Sullivan, Wyoming, and Luzerne Counties.</td>
<td></td>
</tr>
<tr>
<td>07–03.0</td>
<td>Surficial geology of the Laporte 7.5-minute quadrangle, Sullivan County.</td>
<td></td>
</tr>
<tr>
<td>07–04.0</td>
<td>Surficial geology of the Avoca 7.5-minute quadrangle, Luzerne and Lackawanna Counties.</td>
<td></td>
</tr>
<tr>
<td>07–05.0</td>
<td>Surficial geology of the Dutch Mountain 7.5-minute quadrangle, Wyoming, Sullivan, and Luzerne Counties.</td>
<td></td>
</tr>
<tr>
<td>07–06.0</td>
<td>Surficial geology of the Sweet Valley 7.5-minute quadrangle, Luzerne County.</td>
<td></td>
</tr>
<tr>
<td>07–07.0</td>
<td>Surficial geology of the Noxen 7.5-minute quadrangle, Wyoming and Luzerne Counties.</td>
<td></td>
</tr>
<tr>
<td>07–08.0</td>
<td>Surficial geology of the Harveys Lake 7.5-minute quadrangle, Luzerne County.</td>
<td></td>
</tr>
<tr>
<td>07–09.0</td>
<td>Surficial geology of the Elk Grove 7.5-minute quadrangle, Sullivan, Columbia, and Lycoming Counties.</td>
<td></td>
</tr>
<tr>
<td>07–10.0</td>
<td>Surficial geology of the Red Rock 7.5-minute quadrangle, Luzerne, Sullivan, and Columbia Counties.</td>
<td></td>
</tr>
<tr>
<td>07–11.0</td>
<td>Surficial geology of the Trout Run 7.5-minute quadrangle, Lycoming County.</td>
<td></td>
</tr>
<tr>
<td>07–12.0</td>
<td>Surficial geology of the Lenoxville 7.5-minute quadrangle, Lycoming County.</td>
<td></td>
</tr>
<tr>
<td>07–13.0</td>
<td>Surficial geology of the Carbondale 7.5-minute quadrangle, Lackawanna County.</td>
<td></td>
</tr>
</tbody>
</table>
New Edition of Map 10

The Bureau of Topographic and Geologic Survey recently released a new edition of Map 10, Oil and Gas Fields of Pennsylvania, compiled by former staff geologist Karen McCoy and student intern Zachary Schmitt. This page-sized, full-color map has been updated to more accurately display the size and location of oil and gas fields. Copies of Map 10 are free upon request (see Survey address on back cover). The map may also be viewed on our web site at www.dcnr.state.pa.us/topogeo/maps/map10.pdf.

Meet the Staff—Part 4

In this issue of Pennsylvania Geology, we continue our “Meet the Staff” series, the first three parts of which appeared in volume 36. Below you will learn about Laboratory and Geochemical Services and meet the two geologists who work in that section.

LABORATORY AND GEOCHEMICAL SERVICES. The geologists assigned to the Laboratory and Geochemical Services area provide analytical support for geological investigations conducted by the Survey and other state agencies. Laboratory instrumentation includes an X-ray diffractometer that is used for mineral identifications and a scanning electron microscope (SEM) that is capable of obtaining high-resolution images of minerals, rock textures, and microfossils (see Pennsylvania Geology, v. 33, no. 3, p. 2–12). The SEM is equipped with an energy-dispersive spectrometer and (just recently) a cathodoluminescence detector, giving it analytical capabilities that have been used in a variety of projects. The Survey laboratory also has petrographic (transmitted light) and ore (reflected light) microscopes, and rock preparation tools, such as rock saws, lapidary equipment, and a number of crushing and grinding machines. A geochemical laboratory includes a magnetic separator and liquid chemicals, which are used for sample preparations.

John H. Barnes. John, a Senior Geologic Scientist, came to the Survey in July 1970 directly from graduate school, where he earned an M.A. in geological sciences. While performing extensive laboratory work on clay minerals for his thesis project on glacial geology, he ac-
quired an interest in laboratory instrumentation. John brought that interest to the Survey, which happened to be advertising for a geologist to work in its recently upgraded X-ray laboratory. He played a role in several later upgrades to the X-ray diffractometer and the replacement of an X-ray fluorescence spectrograph with the SEM, and he oversaw the addition this fall of the SEM’s state-of-the-art cathodoluminescence detector. John has found that, in addition to keeping up with such technological changes, one of the more interesting challenges in providing laboratory services has been helping to see the labs through six moves and one major flood.

As part of Laboratory and Geochemical Services, John handles requests that range from the X-ray diffraction identification of a single sample to laboratory support for major studies lasting several years. Although the section did not always exist as such, John has provided this type of support throughout his years at the Survey. In the 1970s, he participated in a study of the chemistry of sublimates forming around vents above burning anthracite seams and culm banks (Mineral Resource Report 78). In the 1980s, he worked with fellow geologist Bob Smith (now retired) studying the geology and mineralogy of the Reading Prong. The project proved very timely, as the risk of indoor radon in that region was becoming apparent. Today, John is assisting Bob with analyses of serpentinites and other ultramafic rocks found along the Pennsylvania-Maryland border. He is also aiding fellow Survey geologists Christopher Laughrey and Jaime Kostelnik in their study of natural gas reservoirs in carbonate rock.

John’s duties at the Survey extend beyond his work with the laboratory. He is also assigned to GIS Services, an area that will appear in a future “Meet the Staff” article. As a member of that section, John is in the early stages of updating Open-File Report 97–04, Directory of the Nonfuel-Mineral Producers in Pennsylvania, as a spatial database. The directory, which he compiled, is a popular reference listing sources of products such as sand and gravel, crushed stone, and dimension stone that are used, among other purposes, for the construction of roads, buildings, and monuments. John is also the author or coauthor of a number of other publications, including three of the Survey’s Educational Series booklets.
Stephen G. Shank. Steve, who holds a Ph.D. in geosciences, received most of his education in Pennsylvania, although graduate studies took him to the gabbros of the Duluth Complex in Minnesota and the ultrapotassic plutonics of the Bearpaw Mountains in Montana. He came to the Survey as a Senior Geologic Scientist in March 2006 from the Pennsylvania Department of Environmental Protection, where he had reviewed soil and groundwater remediation projects at industrial and commercial sites. At the Survey, Steve specializes in geochemistry, petrology, and mineralogy.

Like John, Steve is assigned to two work areas. In Laboratory and Geochemical Services, his main function has been to answer requests related to rock and mineral resources and identification, and soil and rock geochemistry. Examples include identifying sources of high-purity glass sand, carbonate whiting, and asbestos in serpentine, and identifying the rocks used for arrowheads from an archeological excavation in southeastern Pennsylvania. In addition, Steve staffs educational displays at a number of local rock and mineral shows to aid in the public outreach efforts of the Survey.

Steve’s other work area is Geologic Mapping Services (to be covered in a future “Meet the Staff”), where he is focusing on field, petrographic, and geochemical studies of serpentinites and related rocks in the Piedmont province of Pennsylvania. Although there has been little modern study, the serpentinites are a key aspect to understanding the geologic history of the Appalachian Mountains in the state. The serpentinites are variable in nature and setting, and a number of different theories have been proposed for their origin. They may represent continental intrusions, remnants of ancient seafloor, massive slump deposits, or the roots of a volcanic arc that formed along the continental margin in the early Paleozoic. In addition, the thin, poor soils formed from the serpentinites are noted for their characteristic prairie-type flora of warm-season grasses, pitch pine, and red cedar. Unfortunately, in southeastern Pennsylvania, the suppression of fires has changed the original vegetation and resulted in the spread of invasive species. Steve’s field and geochemical studies will be useful in identifying the specific areas underlain by serpentinite that are best suited for reestablishment and preservation of the unique vegetation.
Rodger Faill, a preeminent field and structural geologist, retired in 2007 after almost 42 years at the Survey. Rodger, who earned his Ph.D. from Columbia University, is one of only a few geologists in the Fourth Survey to have mapped geology and/or studied structure in nearly all parts of the state. His early work in the Ridge and Valley province resulted in four Atlas reports detailing the stratigraphy, structure, and mineral resources of several quadrangles in central and north-central Pennsylvania. His last Atlas report was on the geology and mineral resources of an area straddling the Allegheny Front in west-central Pennsylvania, where he deciphered the complex Tipton fault block structure. Rodger also authored or coauthored three other reports in the Survey’s formal series, the most recent of which was an earthquake epicenter map and catalog. His final projects include field mapping in the Piedmont province of southern York and Lancaster Counties and compiling statewide maps and datasets of fold axes and faults. During his long career, Rodger gave numerous talks, contributed to several field conference guidebooks, and has had many articles published by other geological organizations and major geological journals (e.g., a three-part series on “A Geologic History of the North-Central Appalachians” in the American Journal of Science). Because of Rodger’s expertise, he was sought out by Survey staff and outside geologists for his insights, and he was often asked to review papers because of his excellent writing and organizational skills. In retirement, Rodger continues to work on geological topics that interest him, but he also spends more time pursuing his other interests. He has a love for fine arts and classical music—he even once volunteered as a classical music disc jockey. He also enjoys sailing on the lake near his New Hampshire cabin, golfing, and traveling by train with his wife Carol, among many other activities.
When Vik Skema retired last year, the Survey lost another well-respected and highly knowledgeable geologist in the Geologic Mapping program. Vik came to the Survey to assist with the cleanup after the devastating tropical storm Agnes flood of 1972, having earned his B.S. in geology from the Michigan Technological University. He was soon assigned to the Geologic Mapping Division, where he became an expert on coal resources and stratigraphy in the bituminous coal fields of western and north-central Pennsylvania. Over the span of his career, Vik had numerous projects, most of which were published in the Survey’s Mineral Resource Report series. Early on, he collected data on the bituminous coal reserves of the state, and he made detailed stratigraphic and sedimentologic studies of the Upper Freeport coal and associated rocks in parts of southwestern Pennsylvania. In the 1980s, Vik compiled and mapped coal crop lines, mined-out areas, and structure for all of Washington and Westmoreland Counties. Later, Vik was a key member of a team brought together to study the possibility of remining and reclaiming the Tangascootack drainage basin in Clinton County. His analysis of the stratigraphic framework of the area was presented at an NETL Pittsburgh Coal Conference and at a Society of Mining Engineers Annual Meeting in the late 1990s. In addition to these assignments, Vik spent considerable time on service requests, logged thousands of feet of drill core, and led or contributed to several Annual Field Conferences of Pennsylvania Geologists (the most notable being the 2005 conference in the New Castle area).

In his retirement, Vik continues to pursue his passions. He still works with colleagues on interesting geologic problems (e.g., the origin of the diamicritites of the Spechty Kopf Formation in south-central Pennsylvania and into Maryland). In the past several years, he has hiked about 300 miles of the Appalachian Trail, of course studying the geology along the way. He also enjoys golf outings with some of his former coworkers and traveling around the country with his wife Dianne in their pop-up camper.
CONTENTS

All is culm ................................................................................................ 1
Coal recovery from mining and processing wastes ..................................... 2
PAMAP—Progress toward a digital base map ......................................... 12
New releases ........................................................................................... 14
New open-file reports available online ................................................. 14
New edition of Map 10 ......................................................................... 16
Meet the staff—Part 4 .............................................................................. 16
Fond farewells ......................................................................................... 19

ON THE COVER

A variety of equipment that is used by the Hazleton Shaft Corporation in its effort to recover additional anthracite coal from the culm banks left behind by previous mining efforts (see article on page 2). Photograph by George E. W. Love.

PENNSYLVANIA GEOLOGY

PENNSYLVANIA GEOLOGY is published quarterly by the Bureau of Topographic and Geologic Survey, Pennsylvania Department of Conservation and Natural Resources, 3240 Schoolhouse Road, Middletown, PA 17057–3534. Editors: Anne B. Lutz and Caron E. O’Neil. Contributed articles are welcome. Guidelines for manuscript preparation may be obtained at www.dcnr.state.pa.us/topogeo/pub/pageolmag/pageolguide.aspx or by contacting the editors at the address listed above.
STATUS OF PAMAP ORTHOPHOTOGRAPHY AS OF JULY 2007
(See article on page 12.)

Distribution of PAMAP orthophotography by year flown. See page 13 of text for additional explanation and information on data availability.

Bureau of Topographic and Geologic Survey
Department of Conservation and Natural Resources
3240 Schoolhouse Road
Middletown, PA 17057–3534

Address Service Requested