VOL. 28, NO. 3/4

Pennsylvania GEOLOGY

COMMONWEALTH OF PENNSYLVANIA
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ON THE COVER

Ice accumulated as a result of the slow discharge of groundwater from bedding planes of sandstone in the Homewood Member of the Pottsville Formation (Pennsylvanian age), McConnells Mill State Park, Lawrence County. Numerous groundwater discharges occur along the walls of Slippery Rock Gorge, contributing to the base flow of Slippery Rock Creek. Photograph by Gary M. Fleeger.

PENNSYLVANIA GEOLOGY

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Contributed articles are welcome. For further information and guidelines for manuscript preparation, contact D. M. Hoskins at the address listed above.

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STATE GEOLOGIST'S EDITORIAL

When Nature Draws the Map

The title above is taken from page 16 of the January/February 1998 issue of *Nature Conservancy*, the magazine of The Nature Conservancy, a national organization that protects land and waters to preserve natural living communities. The author of the article states that the maps now used by the Conservancy are "delineated not by political lines or national borders, but by the realms of climate and **geology**" (highlight added). Whereas biological-diversity protection formerly was directed at individual species and small habitat patches, biologists now recognize that larger systems—ecosystems—must be the focus of their efforts. They now use geology as one criterion to define these larger systems.

Geologic maps of bedrock and surficial materials provide basic information for many human endeavors. They long have been used to locate economic minerals and rocks that support our economies and our societal and personal living standards. But, increasingly, geologic maps are being used for many other purposes. For example, they can help define ecological regions, the large natural land areas that support economically valuable or endangered ecosystems for which management and protection are required. It is in these regions, defined by geology and climate, that conservation of biological diversity is now being targeted.

The geology of every land region of our planet determines what we observe as we look out upon our landscapes. Hills and dales, and mountains and lowlands result from differences in resistance to weathering and erosion of the underlying bedrock. The soils on which plant life survives are determined by the constituent minerals of the same bedrock. The quality and quantity of groundwater in a region depend on the rock-defined aquifers. The mineral and water content of the rocks and soils and differing elevations of the landscapes combine to produce a variety of ecological environments, each having a diversity of biological entities.

Geologic maps, combined with their topographic counterparts, are a necessary and powerful tool now being used in defining the key tracts of biological diversity that deserve protection.

Donald M. Hoskins
State Geologist

Of Ice and Waters Flowing: THE FORMATION OF PITTSBURGH'S THREE RIVERS[1]

by John A. Harper
Bureau of Topographic and Geologic Survey

The very idea of western Pennsylvania's creeks and rivers flowing northward into Canada might strike you as being exceedingly strange, given the general present-day southwesterly drainage directions. Almost all of the streams in this area drain into the Ohio River, which in turn drains into the Mississippi River and eventually into the Gulf of Mexico. They have done so since before humans set foot on the North American continent. But this was not always so. A significant change in stream drainage occurred during the last few hundred thousand years of the earth's history. The following story of how this happened, as deduced by geological investigations carried out over the past 120 years, is one of the more interesting chapters in the geologic history of western Pennsylvania.

PENNSYLVANIA'S NORTHWEST PASSAGE. The stream patterns of western Pennsylvania and neighboring states as they now occur are shown in Figure 1. Compare this map with Figure 2, which shows the same area before the Ice Age (the Pleistocene Epoch), approximately 800,000 to 1,000,000 years ago. At that time, the drainage direction was generally northwestward toward Canada rather than south and west into the Mississippi Valley (based on studies of topography and depth to bedrock in the river valleys). The Monongahela River was then the dominant river in southwestern Pennsylvania. It flowed north, in a channel approximately coincident with its present channel, to the present site of Pittsburgh, and from there it followed the channel of the present Ohio River to Beaver. At Beaver, the Monongahela flowed northwest up what is now the Beaver River valley, past New Castle and Youngstown, and finally into an "ancestral Erie basin" (Figure 2). In stunning contrast with the modern river system of the area, the Ohio River was a mere tributary of the Monongahela, flowing from south of Moundsville, W. Va., to East Liverpool, Ohio, and entering the Monongahela just south of New Castle, Pa.

[1]Modified from *Allegheny Watershed Network News,* v. 1, no. 1, p. 6–7, and v. 1, no. 2, p. 4–5.

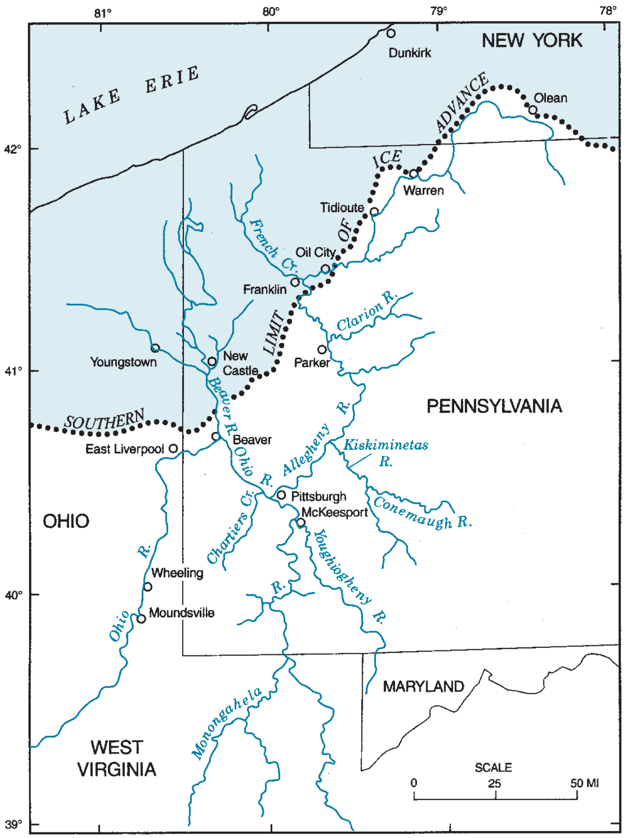

Figure 1. Modern streams drain into the Ohio River and, eventually, into the Mississippi River and Gulf of Mexico. The part of northwestern Pennsylvania that underwent glaciation is shown in color. Modified from Wagner and others (1970).

Even more astonishing, the present Allegheny River was three separate and unrelated rivers that drained different parts of the state. The "Lower Allegheny" originated in Elk, Forest, and Jefferson Counties, followed the course of the present-day Clarion River, and then flowed south to join the mighty Monongahela at what is now Pittsburgh. The "Middle Allegheny" started northeast of Tidioute in Warren County and followed a course through Oil City and Franklin in Venango County. At Franklin, it turned northwest along what is now French Creek and flowed across Crawford and Erie Counties into the "ancestral Erie basin." The "Upper Allegheny" began in northern Pennsylvania and southern New York and flowed across Cattaraugus and Chautauqua Counties, N. Y., from Olean to Dunkirk and into the "ancestral Erie basin."

THE ICEMAN COMETH. During the Ice Age there were four major advances and retreats of the great continental ice sheets that have been recognized throughout the northern hemisphere. Two or three of these, called the Illinoian and the Wisconsinan (and some earlier pre-Illinoian, possibly Nebraskan), are deduced from deposited materials to have reached into western Pennsylvania, but none of them reached

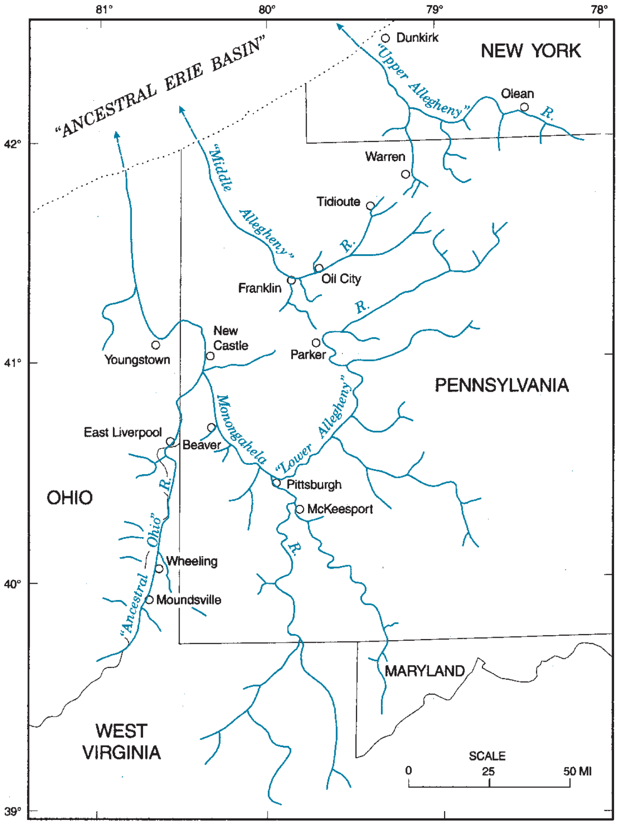

Figure 2. The stream pattern of western Pennsylvania before the Ice Age, as determined from geologic mapping over the past 120 years. Notice that the Monongahela was the major stream in western Pennsylvania, there were three Allegheny rivers, and all of the streams drained northward toward Canada. Modified from Leverett (1934) and Wagner and others (1970).

as far south as Pittsburgh (Figure 1). As the earliest glacier moved into northwestern Pennsylvania about 770,000 years ago, the south-flowing ice blocked the northwest-flowing streams and caused lakes to form along the leading edge of the glacier. Eventually, the lakes became so deep that the water flowed over the divides (hilltops and ridges separating streams), reversing the ancient drainage of the Monongahela, "Middle Allegheny," and "Upper Allegheny" Rivers. (It should be noted that Sevon, 1992, p. 88, believed that the Allegheny drainage reversal occurred before glaciation commenced.)

The water had to go somewhere. Since it could not flow northward through the ice, it took a southerly course in all of these rivers, carving new water gaps through ridges, and taking over channels formed by established streams—Nature's version of eminent domain. These rivers have since followed a southerly course. The "Upper Allegheny" River flowed approximately along the edge of the glacier to the "Middle Allegheny" River drainage area, where the two rivers joined. Then they continued south to the "Lower Allegheny" drainage area, forming one continuous river. The Monongahela backed up and flowed along the ancestral Ohio River channel, following its course in reverse flow direction back to Moundsville, W. Va. There, the river eroded through the drainage divide separating the Ohio and Kanawha Rivers and began flowing westward along the approximate southern edge of the maximum advance of glacial ice to the Mississippi. Once the Ohio began draining into the Mississippi, the Monongahela and Allegheny became its tributaries.

LANDSCAPING THE REAL ESTATE. Prior to the Ice Age, the river valleys had been very shallow (Figure 3A). The rivers flowed across a gently rolling plain, not unlike the present-day Atlantic and Gulf coastal plains. River sediment consisted of locally derived material and was typically only a few feet thick. During the Ice Age, however, glacial meltwaters greatly augmented the natural flow of the rivers, generating enough energy to scour the landscape and to transport large quantities of silt, sand, and gravel brought into Pennsylvania by the glaciers. The river valleys consequently were widened, and their floors were covered with a thick blanket of debris that had been washed out of the ice, as shown in Figure 3B. After the early glacier retreated and after each succeeding glacial invasion, the earth's crust, which each time had been depressed by the weight of the ice, began to rebound. As the land surface rose, the rivers began cutting down into the surrounding bedrock, sometimes creating new channel segments. Remnants of the old valley floors, carpeted with alluvial (stream-borne) sediments, were left stranded high above present stream levels (Figure 3C). These remnants, or terraces, can be seen at intervals all along the Ohio, Allegheny, and Monongahela Rivers and their tributaries. Troy Hill on Pittsburgh's North Side is one of the best examples of these in the Pittsburgh area. From a distance it looks like someone took a large knife and cut a flat-topped chunk out of the northern wall of the Allegheny River valley. Farther north, these terraces can be seen at Ford City, Parker, Oil City, Tidioute, Warren, and many places in between. Along the Ohio, you can see evidence for these terraces at Monument Hill on Pittsburgh's North Side, from Bellevue to Emsworth, and downstream to Rochester and Beaver. Along the Monongahela, prominent terraces occur at Homestead, Rankin, East Pittsburgh, Clairton, and farther south at Belle Vernon, California, Carmichaels, and Masontown, among others. Similar terraces occur along the Youghiogheny River from McKeesport to Connellsville, along the Kiskiminetas and Conemaugh Rivers from Leechburg to Johnstown, and along the other minor rivers and major creeks throughout the Ohio River drainage area.

. . .PITTSBURGH STYLE. Even within Pittsburgh itself, there are many examples of the old river bottoms, particularly where the old Alleghe-

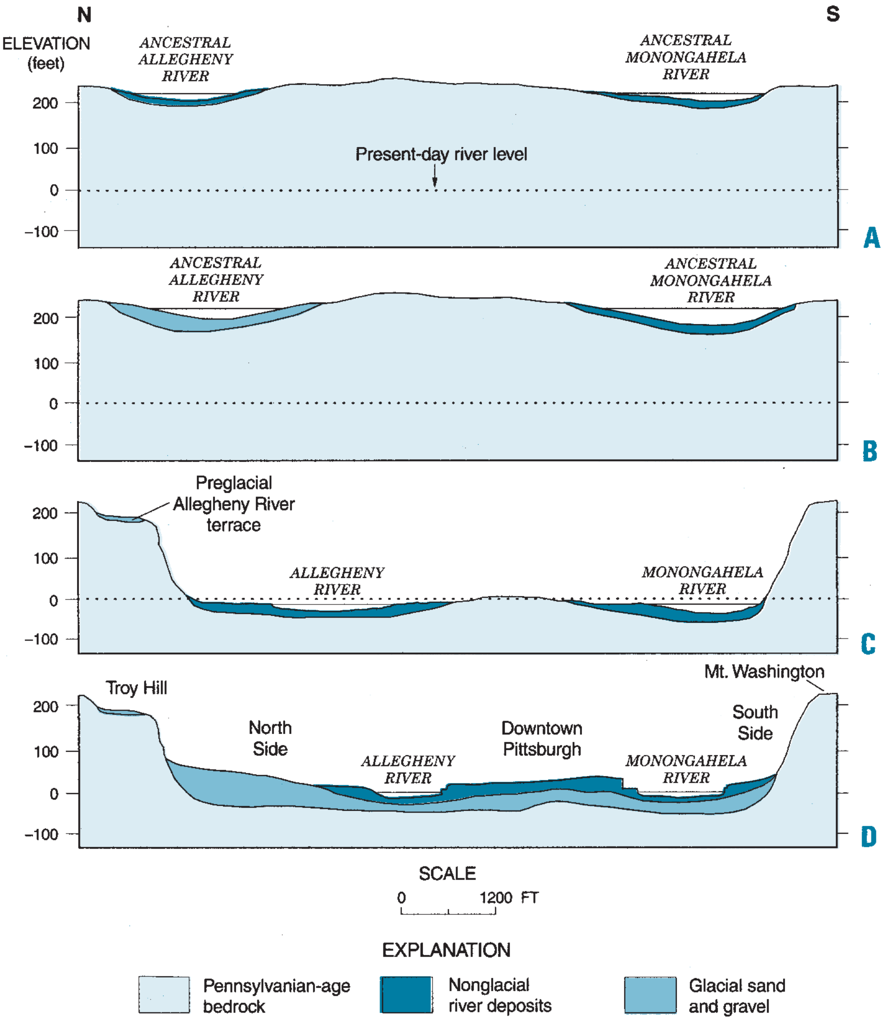

Figure 3. Development of the Allegheny and Monongahela River valleys over the past 1 million years, as shown in cross section. A. Before the first glaciation about 770,000 years ago, the rivers flowed in shallow valleys amid low-relief plains. B. During an early (Nebraskan?) glaciation (about 770,000 years ago), increased runoff helped carve the river channels deeper while filling the Allegheny Valley with glacially derived sand and gravel. C. Following the initial glaciation, the rivers began to cut downward and laterally into bedrock as the land began to rise. During successive glaciations, this created a single, very wide valley at present-day Pittsburgh and left remnants of the old river valley floors 200 to 250 feet above the present river level. D. During the last (Wisconsinan) glaciation (about 75,000 to 10,000 years ago), the Allegheny River cut down a little more and filled the entire valley with glacially derived sand and gravel. Since that time, the river banks and downtown Pittsburgh have been covered only with locally derived, nonglacial river sediment.

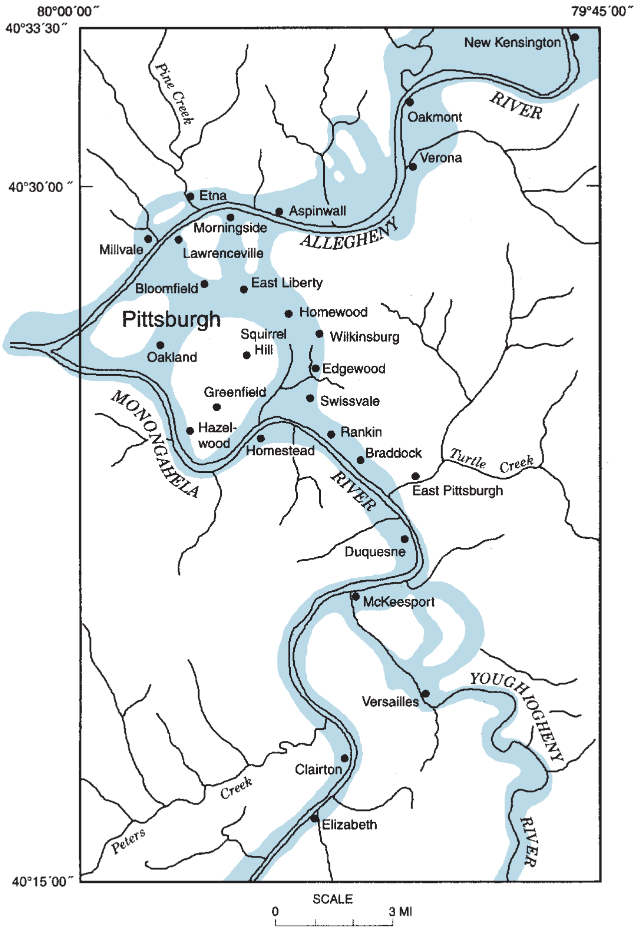

Figure 4. Old (colored areas) and new river channels near the lower ends of the Allegheny and Monongahela Rivers. Notice that the rivers once flowed through the eastern neighborhoods of Pittsburgh. Modified from Leverett (1934) and Wagner and others (1970).

ny drained into the Monongahela. Most people who live and work in Pittsburgh are completely unaware of just how much of the city and its suburbs lie on abandoned channels, not at river level, mind you, but 200 to 250 feet above the present elevation of the three rivers. The University of Pittsburgh's Cathedral of Learning in Oakland sits on about 40 feet of sand, gravel, silt, and clay that was deposited by the preglacial Monongahela River. Figure 4 shows the various paths the rivers have taken through Pittsburgh over the past million years or so, leaving areas such as Squirrel Hill, Stanton Heights, Highland Park, and the Hill District as islands of bedrock within the winding, interfingering channels. The effect of these various drainage channels on the settlement of Pittsburgh was profound. The Conrail Railroad main line and many of Pittsburgh's principal streets follow the old river bottoms, which were the only direct, natural overland routes toward downtown Pittsburgh from the east.

The rivers continued eroding downward and laterally, and by the time the last glacier advanced into northwestern Pennsylvania about 75,000 years ago, they had gouged their valleys 250 feet lower than the level of the oldest river terraces. They now flowed across bedrock in broad, flat-bottomed valleys having steep walls (Figure 3C). During this latest glaciation, only local changes occurred along the rivers. Glacial meltwaters again filled the bottoms of the Allegheny and Ohio River valleys with, in places, more than 100 feet of silt, sand, and gravel, forcing the Monongahela and its tributaries to build up their channels with sediments derived from the hills to the south.

When the Ice Age ended about 10,000 years ago, the volume of water and sediment coming down the Allegheny River decreased substantially. The rapidly flowing rivers cut new shallow channels into the porous sand and gravel and began depositing locally derived sediment once again, resulting in the modern floodplain and low terraces about 10 to 30 feet above present river level (Figure 3D).

THE "FOURTH RIVER" DEMYTHIFIED. The glacial debris filling the Allegheny and Ohio Valleys from Warren to the West Virginia border is the primary source of usable water along the floodplains. Many people, upon hearing about this, imagine that the water flows in long, sinuous caverns well below river level. For example, I grew up with the "knowledge" that my hometown of Coraopolis, 9 miles down the Ohio River from Pittsburgh, received its water from a large cave beneath the borough waterworks. Because of such fantasies, the sand-and-gravel valley fill is frequently given the erroneous names "Pittsburgh's Fourth River" and "Pittsburgh's Underground River." To the ardent cave divers in the reading audience, I must pass along the discouraging news that nothing could be farther from reality. There are no caves, no fissures, and no cavities—just the interconnection of tiny, natural pore spaces between sand grains and pebbles that allows the water from the rivers, and rain on the floodplains, to move freely, if a little slowly, into and through the valley fill. So, the next time you cool off with a refreshing glass of water or a dip in the pool in one of the numerous river towns along the Allegheny and Ohio Rivers, you can credit the glaciers. The ice is gone, but the legacy lives on.

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New Mineral-Producer Directory Provides Another Snapshot of an Industry

by John H. Barnes
Bureau of Topographic and Geologic Survey

For the fifth time since 1965, the Bureau of Topographic and Geologic Survey has compiled a *Directory of the Nonfuel-Mineral Producers in Pennsylvania*, previously published as Information Circular 54. This directory is a list of producers of mineral products used in the construction industries, agriculture, and manufacturing. Only coal, oil, and natural gas are excluded. In addition to serving as a resource for consumers of these mineral products, equipment suppliers, and others wishing to locate producers of industrial minerals, the directory provides a snapshot of the industry at the time the directory was compiled. Having recently completed the fifth edition, which is currently available from the Bureau's World Wide Web site as Open-File Report 97–04, and as a printed circular available from the Pennsylvania Aggregates and Concrete Association, it is interesting to see how the industry compares with its condition when the four previous editions were prepared.

In making comparisons from one compilation to another, some cautions are required. In preparing the two most recent compilations, information was gained principally from responses of the state's mineral producers to questionnaires sent to them by the Bureau. Because the responses were voluntary, comparisons between the two editions are dependent on the extent to which mineral producers wished to reveal information about their operations. Some mineral producers did not respond at all, and their operations are not included in the directories. Comparisons could also be influenced by the fact that a small number of the responses to the questionnaires do not fit into easily defined categories, and are therefore open to interpretation.

The method of categorizing data in the directories has changed over the years. The method used for the first three editions (O'Neill, 1965; Hoover, 1971; O'Neill, 1977) is based primarily on the type of rock or sedimentary deposit being mined, whereas that used in the fourth and fifth editions (Berkheiser and others, 1985; Barnes, 1997) is based on the commercial applications of the mined materials. The fourth and fifth compilations are nearly identical in the categories of commodities used, but four new categories were added for the new compilation. The largest of these is topsoil, of which 38 producers were recorded. The second-largest new category is carbonate rock for the absorption of sulfur dioxide from stack emissions of coal-burning power plants, of which nine producers were recorded. This represents a relatively new use for an existing commodity. Two additional categories listed in the new compilation have one entry each: talc and quartz crystals.

In the fourth and fifth compilations, each entry represents a single rock type mined for a single category of commodity at one location. Despite the four newly added categories, there are nearly 100 fewer entries in the fifth compilation of the directory than in the fourth, down to 944 from 1,043 (Table 1). (Comparisons in number of entries between the two recent compilations and the first three compilations are meaningless because of the different method of categorizing data in the first three.) The number of operations listed (quarries, open pits, and so forth) and the number of companies running those operations are also down from the number reported in the fourth edition.

The decline in the number of listings between the fourth and fifth compilations cannot be attributed to any single region or commodity (see back cover). The largest decline per county was in northwestern Pennsylvania, where the number of reporting producers of construction aggregate, which is used predominantly for building roads, dropped by 20 in Erie County and by 10 in neighboring Crawford County. Franklin County, in south-central Pennsylvania, and Wayne County, in northeast-

Table 1. ***Comparison of Number of Entries, Operations, and Companies Listed in Each Edition of Information Circular 54 and the Current Compilation.[1]***

Edition	Publication year	Number of entries	Number of operations	Number of companies
1	1965	–	[2]	[4]453
2	1971	–	[2]	[4]466
3	1977	–	[3,4]900	[4]664
4	1985	1,043	859	689
current	1997	944	695	521

[1]Comparison of number of entries for the first three editions is not possible because of different methods of categorizing.
[2]Data unavailable.
[3]Number approximate.
[4]Includes metal mines, which are not included in statistical comparisons in Table 2.

ern Pennsylvania, had declines of 14 and 9, respectively, in the number of producers of borrow and general fill, which is also used in the construction industry. Fayette and Blair Counties had drops of 8 and 7, respectively, in the combined number of construction aggregate and borrow and general fill operations reported. Clearfield County, in central Pennsylvania, had seven fewer reported listings of refractory operations than in the fourth edition. Other counties for which significant declines were noted include Lancaster, Lackawanna, and Clinton, although no one commodity accounts for the drop in any of those counties.

Increases in the number of listings per county were also widely scattered, but seemed to be especially common in southwestern Pennsylvania (with the exception of the counties bordering West Virginia) and parts of eastern Pennsylvania. The greatest increase was in Clarion County, in western Pennsylvania, and is mostly accounted for by an increase by six in the number of borrow and general fill operations reported in that county. Susquehanna County, in northeastern Pennsylvania, is notable for having an increase by five in the number of reporting dimension stone (in this case, "bluestone") producers. This latter probably reflects a slight increase in the number of responses to our questionnaire, rather than an increase in the number of producers.

Because direct comparisons of listings in the first three editions of IC 54 with listings in the two more recent compilations cannot be made, we must find another way to compare the nonfuel-mineral industry of Pennsylvania at the time of each of the five compilations. The introductory text in the fourth and fifth compilations includes statistical "snapshots" of the industry as revealed by yearly summaries that were published by the now-defunct U.S. Bureau of Mines (USBM), and that are now published by the U.S. Geological Survey. To determine how the industry has changed over the 32-year period since the first edition of IC 54 was issued, we have compiled data from past USBM statistical summaries corresponding to times just preceding the collection of data for each edition. To be consistent with the reporting in the fourth and fifth compilations, we selected USBM data that were collected two years prior to the publication dates of each of the earlier editions of IC 54 (Kerr, 1965; Leaf, 1971; Kebblish, 1979). The USBM data presented here corresponding to the fourth and fifth compilations are updates of preliminary data quoted in those publications (Prosser and others, 1985; U.S. Geological Survey, [1997?]). The results are summarized in Table 2.

It is interesting to note that although the quantity of material mined is higher now than prior to

Table 2. ***Comparison of the Nonfuel-Mineral Industry in Pennsylvania Prior to Publication of Each Edition of Information Circular 54 and the Current Compilation***

Edition	Publication year	Comparison year	Thousand tons[1]	Millions of dollars[1]	Millions of dollars (1994 dollars)[2]	Dollars per ton (1994 dollars)	Dollars per person (1994 dollars)
1	1965	1963	75,532	296	1,213	16.06	106
2	1971	1969	98,738	379	1,418	14.36	121
3	1977	1975	87,662	486	1,125	12.83	94
4	1985	1983	71,237	620	789	11.08	67
current	1997	1994	111,254	992	992	8.92	82

[1]Tonnage and value from Kerr (1965), Leaf (1971), Kebblish (1979), Prosser and others (1985), and U.S. Geological Survey [1997?].

[2]Conversion to constant 1994 dollars is based on the Producer Price Index for "concrete ingredients and related products" established by the U.S. Bureau of Labor Statistics.

any of the previous compilations, the value in constant 1994 dollars has been steadily declining over the past 32 years, suggesting that nonfuel-mineral resources as a whole are presently abundant and relatively inexpensive in Pennsylvania. This is good news for the consumer of these mineral products and for the taxpayer who ultimately pays the bill for highway construction. The final column in Table 2 indicates the value of nonfuel-mineral resources produced per person in Pennsylvania, using constant 1994 dollars. Even though there has been an apparent steady decline in real value of nonfuel-mineral resources since 1963, the quantity of nonfuel-mineral resources now being produced is so great that the total value of minerals produced per person was higher in 1994 than in 1983. Nonfuel-mineral resources are an important component of Pennsylvania's economy. They are vital to the support of the state's construction industries and to the maintenance of its infrastructure.

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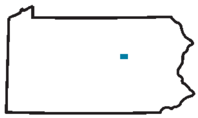
Geology of the Allenwood and Milton Quadrangles



The Bureau of Topographic and Geologic Survey recently published **Atlas Report 144cd, Geology and Mineral Resources of the Allenwood and Milton Quadrangles, Union and Northumberland Counties, Pennsylvania,** by Jon D. Inners. The report consists of a 135-page text accompanied by two full-color plates showing bedrock and surficial units and a two-color plate showing the locations of mineral resources (limestone quarries, shale pits, and iron mines).

The Allenwood and Milton quadrangles are located along the West Branch Susquehanna River in the Appalachian Mountain section of the Ridge and Valley province of central Pennsylvania. The bedrock ranges from the Lower Silurian Tuscarora Formation to the Middle Devonian Mahantango Formation. Pre-Illinoian to Holocene surficial deposits include widespread glacial, periglacial, and colluvial deposits on the uplands, and outwash and alluvial-terrace deposits in the West Branch Susquehanna River valley and tributary-stream valleys. The well-illustrated text contains sections summarizing both the bedrock and surficial stratigraphy of the area; structural geology; environmental and engineering geology; and mineral resources. The bedrock stratigraphy section includes numerous photomicrographs and the description of a new member at the top of the Silurian Tonoloway Formation, the Turbotville Member.

Atlas Report 144cd may be purchased from the State Book Store, 1825 Stanley Drive, Harrisburg, PA 17103–1257, for **$25.36 plus $1.52 state sales tax** for Pennsylvania residents. Orders must be prepaid; please make checks payable to *Commonwealth of Pennsylvania.*

Correlation Chart of Uppermost Devonian through Permian Stratigraphic Units

The Bureau of Topographic and Geologic Survey announces the availability of **Open-File Report 96–49, Correlation Chart Showing Suggested Revisions of Uppermost Devonian Through Permian Stratigraphy, Pennsylvania,** by William E. Edmunds. The chart represents the author's ideas concerning possible changes to the Bureau's correlations shown on the late Paleozoic portion of General Geology Report 75, *Stratigraphic Correlation Chart of Pennsylvania*. Among the major recommendations are the following: (1) the definition of Loyalhanna-equivalent beds in the Anthracite region; (2) extension of the sub-Loyalhanna disconformity long recognized in western Pennsylvania into the east; (3) recognition of a sub-Sharp Mountain Member disconformity in the Anthracite region; and (4) certain nomenclatural revisions, particularly in the Lower Mississippian and uppermost Devonian. These changes are only suggestions, based on the author's many years of work on Carboniferous rocks in the central Appalachians, and do not necessarily reflect approved usage by the Bureau. The report consists of a 36- by 30½-inch computer-drafted correlation chart and an 8-page text that includes 2 pages of references. Charts are available in two forms (both include text): flat (rolled), three-color ink-jet copies at **$7.00 plus $0.42 state sales tax** for Pennsylvania residents; and folded, black-and-white photocopies at **$3.00 plus $0.18 state sales tax** for Pennsylvania residents. Please order from the Bureau at the address given in the following announcement.

Stratigraphic Relations of the Juniata-Tuscarora Contact

The Bureau of Topographic and Geologic Survey recently released **Open-File Report 97–01, Stratigraphic Relations of the Juniata-Tuscarora Contact in Central Pennsylvania,** by Diego I. Sanabria and Allan M. Thompson. The report is a shortened (30-page) version of a Master's thesis presented by Mr. Sanabria to the University of Delaware in 1996. The conclusion of the study, based on outcrop and petrographic data from seven sections in the Ridge and Valley physiographic province between Franklin and Fulton Counties and Lycoming County, is that the change from red sandstones in the Juniata Formation to drab sandstones in the Tuscarora Formation is a valid lithostratigraphic marker. This change in color corresponds almost exactly to a change in sedimentary environment from low-sinuosity braided rivers and high-sinuosity meandering rivers in the Juniata to braided-fluvial, tidal, and wave-dominated shoreline deposits in the Tuscarora. The report includes an excellent discussion of color changes and the chemical behavior of iron during diagenesis.

Open-File Report 97–01 is available for **$2.50, plus $0.15 sales tax** for Pennsylvania residents. The report may be purchased from Open-File Sales, Bureau of Topographic and Geologic Survey, P. O. Box 8453, Harrisburg, PA 17105–8453. Prepayment is required; please make checks payable to *Commonwealth of Pennsylvania*. The report may be examined in the library of the Bureau, Evangelical Press Building, Second Floor, 1500 North Third Street, Harrisburg, and in the Pittsburgh office of the Bureau at 500 Waterfront Drive.

For further information on open-file reports, please contact Jon Inners, Chief, Geologic Mapping Division, telephone 717–787–6029.

Geochemical Analyses Available

URANIUM AND THORIUM ANALYSES OF GRANITIC ROCKS FROM THE READING PRONG

In the mid-1970's, aerial gamma-ray reconnaissance of Pennsylvania by the U.S. Department of Energy revealed the presence of positive anomalies in Berks, Lehigh, and Northampton Counties related to occurrences of uranium and/or thorium. Uranium and thorium are naturally occurring elements that are radioactive. In the reconnaissance aerial survey, data were collected only along widely separated flight lines. To fill in data between the flight lines, a car-borne scintillometer survey was conducted by geologists of the Bureau of Topographic and Geologic Survey along roads traversing the Reading Prong section of the New England physiographic province, which mostly lies in the three counties. This survey was financially supported by the U.S. Geological Survey as part of a larger national investigation. The objectives of the survey were to determine the distribution and amount of mineralization containing uranium and thorium.

One of the results of the survey was the publication in 1985 of a generalized map showing locations in the Reading Prong where instruments recorded gamma radiation in excess of normal background radiation.

Bureau geologists also examined and collected mineralized samples at 64 sites identified as anomalous by the radioactivity-sensing instruments. Most of the samples are from rocks identified as granitic gneiss. Six samples were taken from rocks identified as skarns (lime- and magnesia-bearing silicates). Three were collected from conglomerates at the base of the Hardyston Formation, which geologically overlies the gneisses in the Reading Prong.

The database of the uranium and thorium analyses of these samples is now available through two methods. One is through the Bureau's Internet site, which is located at <*www.dcnr.state.pa.us/topogeo/*>. Instructions for downloading the database are included there. If a printed copy of the analyses is preferred, it may be obtained from Robert C. Smith, II, or John H. Barnes, Bureau of Topographic and Geologic Survey, P. O. Box 8453, Harrisburg, PA 17105–8453.

LIMESTONES FROM CENTRAL AND WESTERN PENNSYLVANIA

Carbonate rocks such as limestone and dolomite have been extensively used at least since the Roman Empire, and new applications are still being found. To provide chemical analyses for current and new applications, the Bureau collects and analyzes samples of carbonate rocks.

Partial chemical analyses of 79 limestone samples from central and western Pennsylvania are now available. These analyses include data for percent $CaCO_3$, $MgCO_3$, and insoluble residues.

Sixty-nine of the samples are from Ordovician rock exposures in central Pennsylvania at Ashcom, Bedford County; Oak Hall, Centre County; Reedsville, Mifflin County; and Union Furnace, Blair County. These rock exposures contain moderately pure limestones and dolomitic limestones that might be suitable for various acid-mitigation processes as well as their current use for construction aggregate.

Ten samples are from rock exposures of Pennsylvanian age in western Pennsylvania. Here, most limestones and dolomitic limestones are thin and less often quarried. However, the presence of some carbonate minerals in rock sequences normally exploited for their coal resources may reduce the amount of acid produced during or after coal mining.

The database of limestone analyses is now available from the Bureau of Topographic and Geologic Survey through the same two methods discussed above for the uranium and thorium database.

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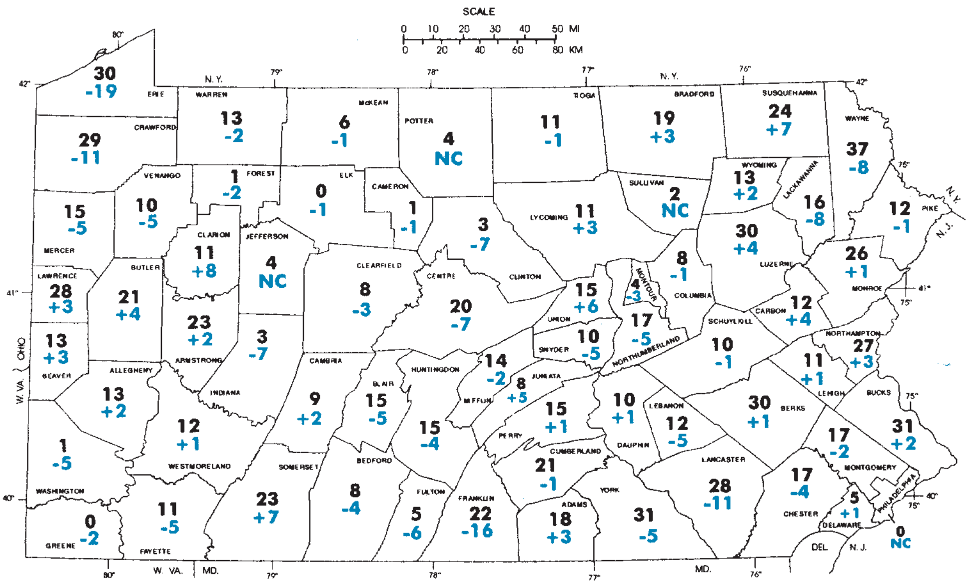
IN COOPERATION WITH THE U.S. GEOLOGICAL SURVEY
TOPOGRAPHIC MAPPING
GROUNDWATER-RESOURCE MAPPING

NONFUEL-MINERAL PRODUCERS IN PENNSYLVANIA

Map showing the number of listings for each county in the current edition of the *Directory of the Nonfuel-Mineral Producers in Pennsylvania* (Barnes, 1997), and the difference in the number of listings from the previous edition (Berkheiser and others, 1985). (See article on page 9.)



EXPLANATION

24 Number of listings in current compilation
+3 Increase in number of listings from 4th edition to current compilation
–2 Decrease in number of listings from 4th edition to current compilation
NC No change in number of listings from 4th edition to current compilation

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