

The History of the Aggregates Industry in Pennsylvania & the Work of the Pennsylvania Geological Survey

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Dr. Gale Blackmer, Director and State Geologist Pennsylvania Geological Survey

PACA Young Leaders Development Group Conference October 12, 2023

Nonfuel Raw Mineral Production in Pennsylvania

Mineral Commodity	2018 Quantity (1000 metric t)	2018 Value (1000 \$)	2019 Quantity (1000 metric t)	2018 Value (1000 \$)
Cement, masonry	143	19,800	146 20,400	
Cement, Portland	3,370	356,000	3,770	390,000
Clay, common	281	1,870	272	1,840
Lime	854	176,000	937	184,000
Sand and gravel, construction	9,950	94,600	11,100	116,000
Stone, crushed	87,200	1,160,000	94,600	1,380,000
Stone, dimension	48	7,340	38	
TOTAL		1,810,000		2,100,000

Source: USGS 2019 Minerals Yearbook

Pennsylvania: Crushed Stone Sold or Used, by kind

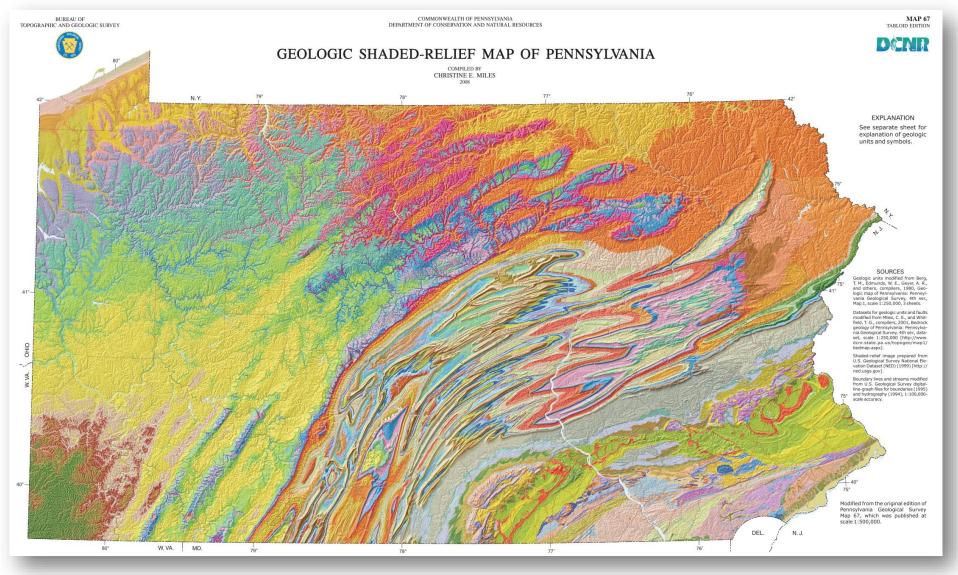
Kind	# of quarries 2005	Quantity (1000 met. tons)	Value (1000 \$)	# of quarries 2006	Quantity (1000 met. tons)	Value (1000 \$)
Limestone	109	61,300	413,000	104	64,600	460,000
Dolomite	13	12,400	79,700	11	11,800	82,200
Marble	1			1		
Sandstone/ quartzite	41	10,800	73,500	42	12,700	91,600
Traprock	7	4,700	33,000	7	6,480	46,800
Granite	7	6,450	40,700	6	4,280	30,600
Slate	11			11		
Misc. Stone	18	9,530	62,400	17	9,320	65,300
Total		107,000	713,000		111,000	788,000

Source: USGS Minerals Yearbook 2006, volume II

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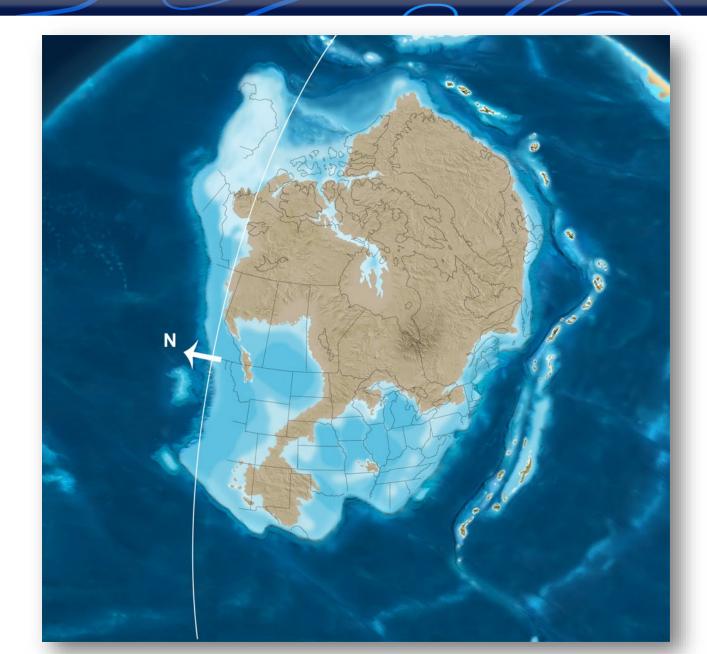
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North America @ 500 Ma, Late Cambrian

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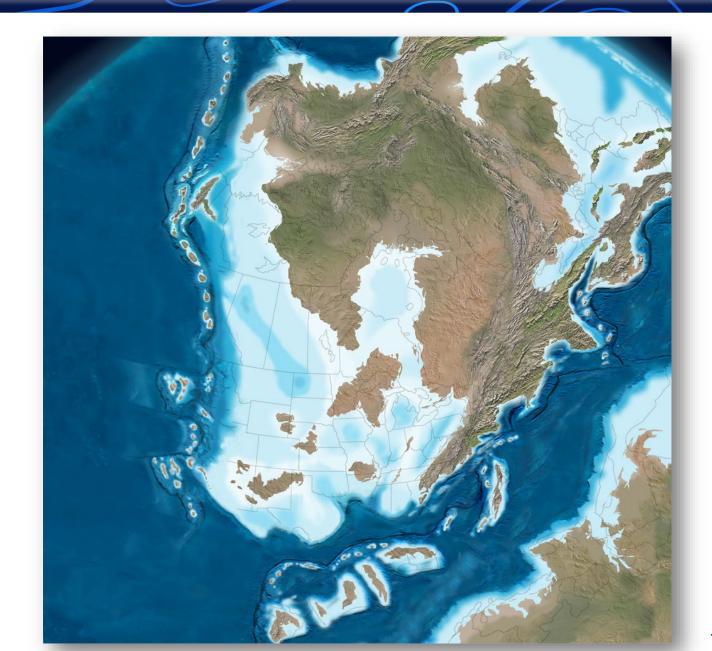
North America @ 450 Ma, Late Ordovician

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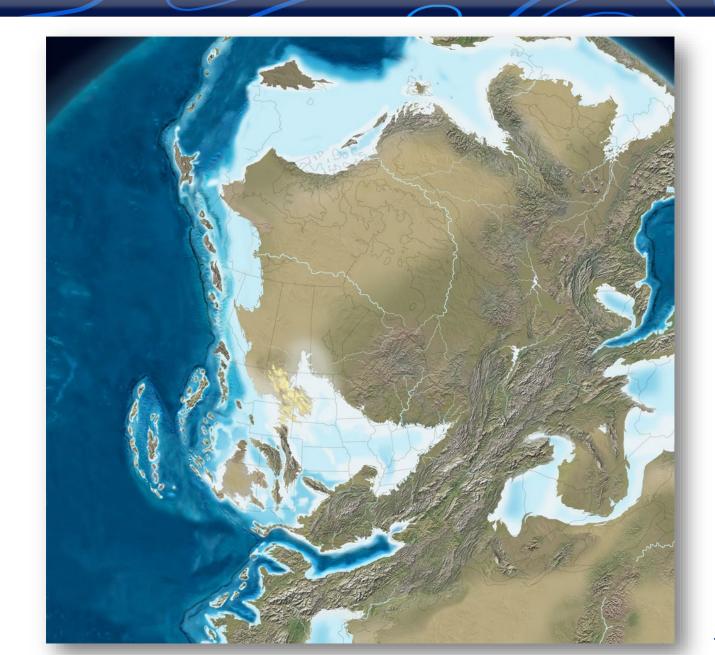
North America @ 360 Ma, Late Devonian

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North America @ 300 Ma, Late Pennsylvanian

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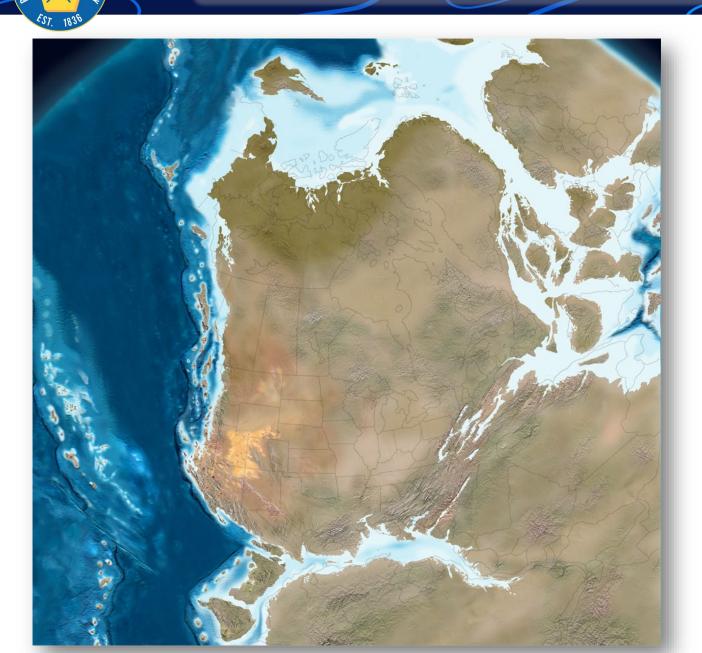
North America @ 210 Ma, Late Triassic



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🗩 rift zone

North America @ 195 Ma, Early Jurassic



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North America @ 170 Ma, Middle Jurassic

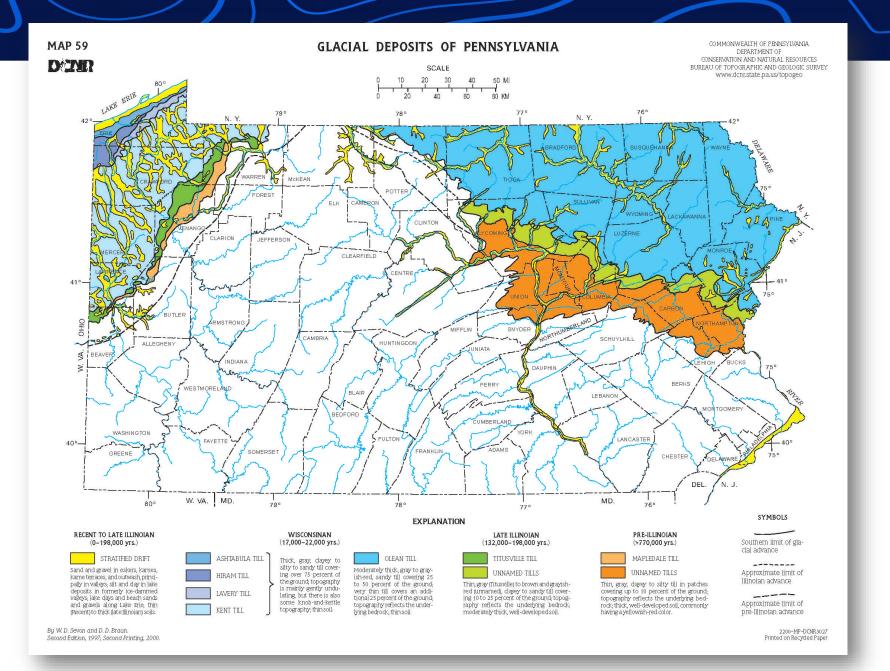


– dark blue = true ocean crust

North America @ 150 Ma, Late Jurassic



Proto-Atlantic Ocean



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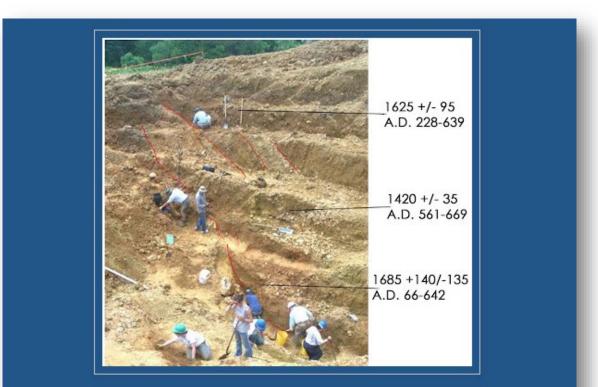
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Earliest Use of Stone in Pennsylvania

Native Americans quarried local stone for tools as early as the Paleoindian period (chert, jasper, quartz, metarhyolite, argillite)



This photo depicts the profile of a 24 foot deep Native American dug pit at the Kings Jasper Quarry site in Lehigh County. The carbon 14 dates mark a relatively stable, steeply sloping surface created after the pit began to backfill. This occured due to natural processes and probably additional Native American quarrying activities in adjacent pits.



Early European Settlement

"Civilization" requires stone

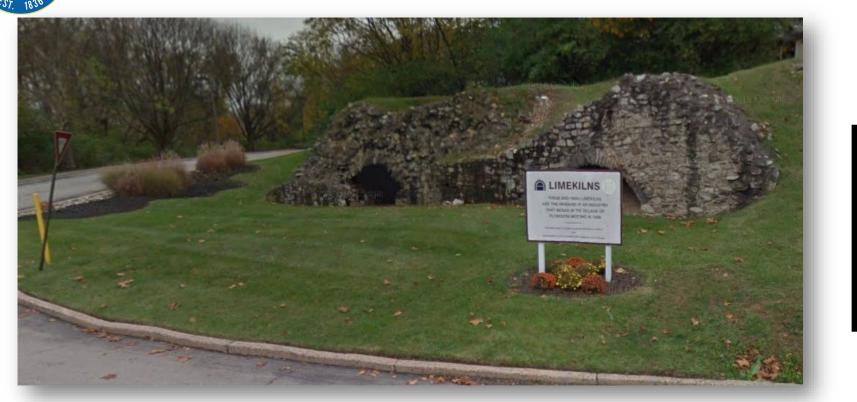


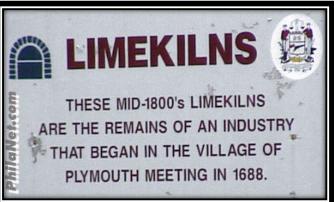


Caleb Pusey House, 1683 Upland, Delaware County

Abandoned quarry hiding out as a pond, Chester County

Limestone





- Fertilizer, mortar, whitewash to protect barns and tree bases.
- Oldest lime kiln in Pennsylvania dates to 1693 (Montgomery County)*

*https://unchartedlancaster.com/2019/03/30/lancaster-county-once-boasted-nearly-500-of-these-silent-stone-sentinels-today-fewer-than-20-percent-remains-unlock-themystery-of-these-ancient-masonry-guardians/ Wood makes poor roads

"I am aware, Gentlemen, that the want of a good, permanent road is, at present, the principal defect in the communication between the middle counties and the metropolis" -Pennsylvania Governor Thomas Mifflin, 1791

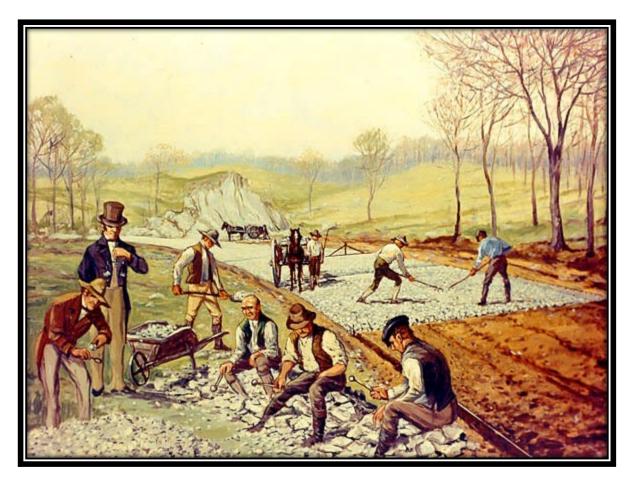
Early roads were constructed of logs laid perpendicular to the path and covered with a layer of soil or planks.



Example of a corduroy road in Ukraine circa 1918.

Roads made of stone are much better

Philadelphia and Lancaster Turnpike, 1795 the first hard-surfaced road in the US



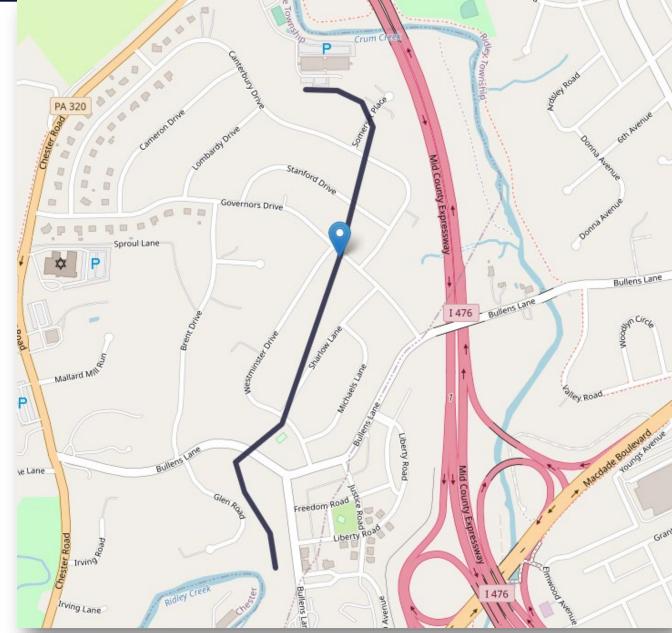
- Foundation of broken limestone and gravel, top layer of smoother, loosely packed stone
- Method devised by Scottish engineer John MacAdam.
- Early aggregate specs: not to exceed 6 ounces in weight or to pass a twoinch ring

Construction of a macadamized road ca. 1823

Railroads

The first railway in Pennsylvania

- Leiper Railroad built to carry stone from Leiper family quarries near Crum Creek to Ridley Creek, Delaware County
- Started operations in 1809
- ³⁄₄ mile long
- Wooden rails, horse-drawn cars
- Replaced by a canal in 1828, then again by a railroad in 1852.
- Second railroad became the Crum Creek Branch of the Baltimore and Philadelphia Railroad (part of B&O Railroad); abandoned in the 1950s



Railroads move stone and need stone

Philadelphia and Columbia Railway

- Construction began 1829, operational 1832
- Part of the Main Line of Public Works, a network of railroads and canals that connected Pittsburgh with Philadelphia



By Unknown author -

http://railroadheritage.org/r1808/01_early_photograph_of_an_early_locomotive_the_tioga_editors_title

First Pennsylvania Geological Survey 1836-1842

- Organized to conduct a geological and mineralogical survey of the state
- Careful mapping set the geologic framework for all the other states along the Appalachian Mountains
- Learned much about the form and arrangement of rock layers and correlation of units across the state

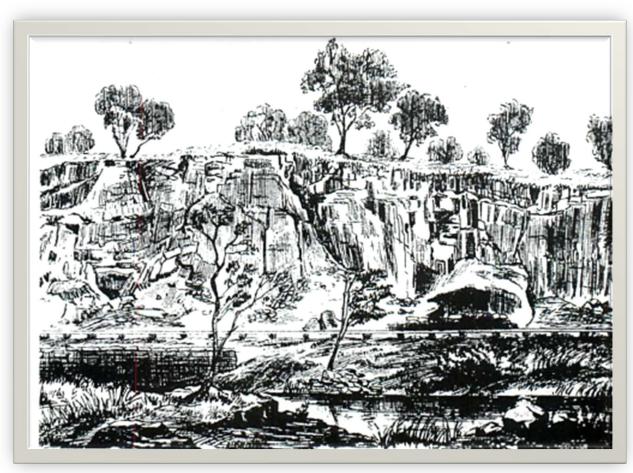


Henry Darwin Rogers State Geologist of the First PA Geological Survey

The First Survey is famous for its beautiful lithographs, sketched by George Lehman

Indian Chief Rock, on the Juniata River near Williamsburg





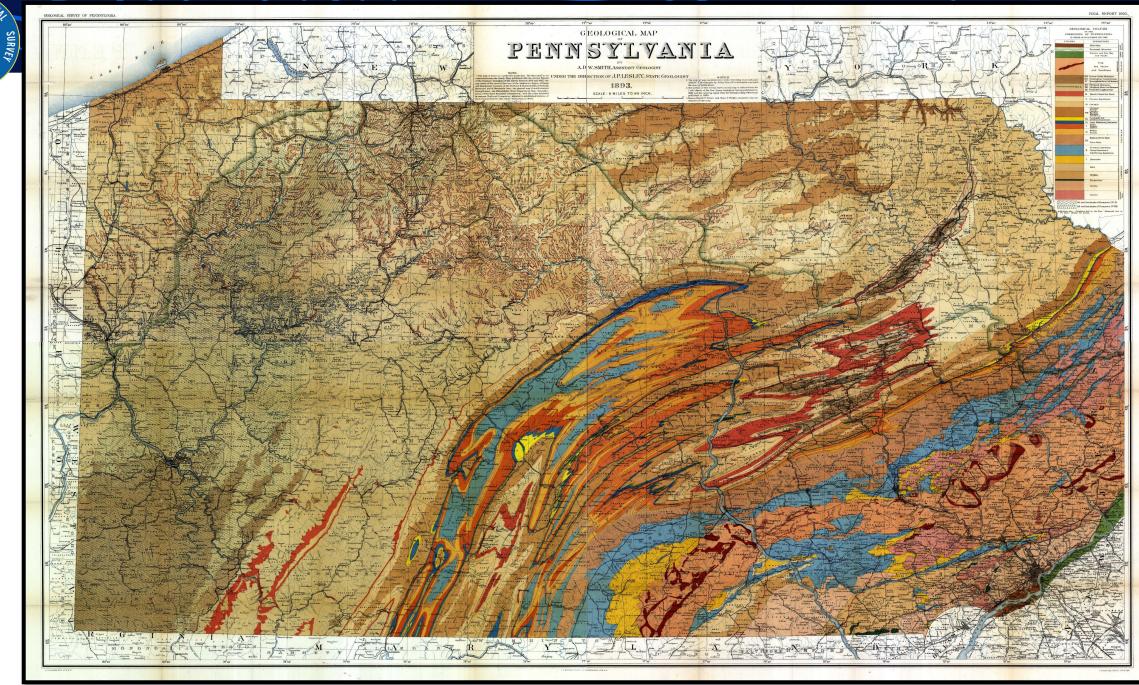
Limestone quarry near Conshohocken

Second Pennsylvania Geological Survey 1874-1889

- Brought on by accelerated industrial growth and discovery of oil.
- More staff, more time, work up areas in more detail
- Nearly 120 atlases and volumes; each project published as it was completed. Geologic maps of all 67 counties.
- Established much of the stratigraphy we use today



J. Peter Lesley State Geologist of the Second Geological Survey



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Third Pennsylvania Geological Survey 1899-1914

- Primarily produced topographic maps in cooperation with U.S. Geological Survey
- Geologic work focused on coal, gas, and oil
- Perpetual funding issues
- In 1910, PA produced nearly a third of the mineral wealth of the US but spent only \$1 on geologic work for each \$65,700 in mineral products.



Richard Hice State Geologist of the Third Geological Survey

Fourth Pennsylvania Geological Survey 1919-forever

- "...undertake, conduct, and maintain...a thorough and extended survey of the State for the purpose of elucidating the geology and topography of the State."
- Enabling legislation assigned many tasks:
 - Mapping and chemical analysis of mineral resources, energy resources, clays, soils, and fertilizers.
 - Mapping and characterization of rock formation that would be useful for highway construction or for any other purpose.
 - Put information into a "form convenient for reference."



Survey Staff, 2019



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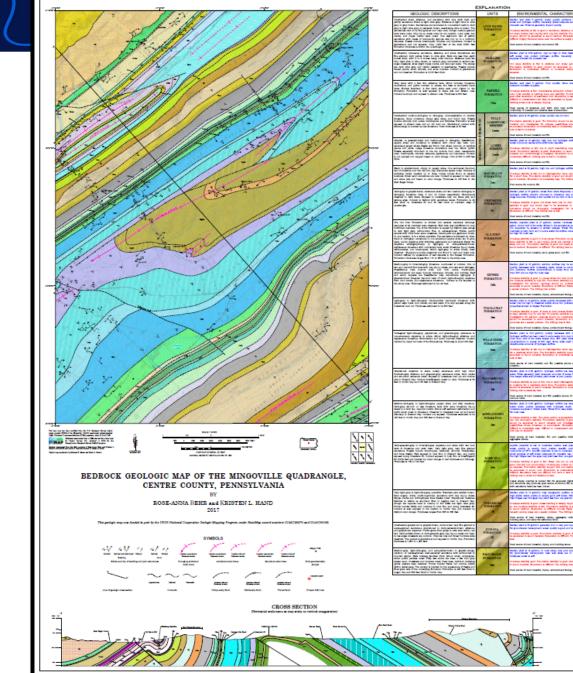
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Survey Products: Analytical data

- Geochemistry
- PennDOT lab tests
- In-house labs for microscopic work

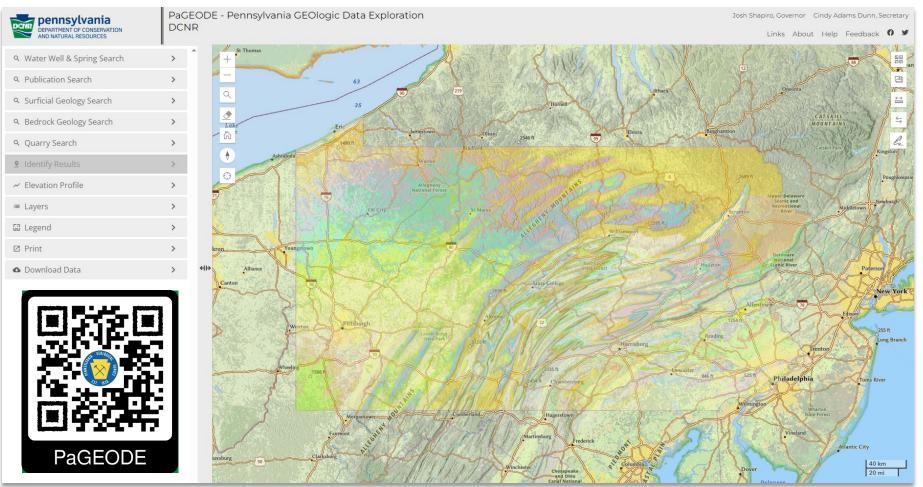


Survey's first X-ray diffractometer, 1958

PA Geologic Data Exploration

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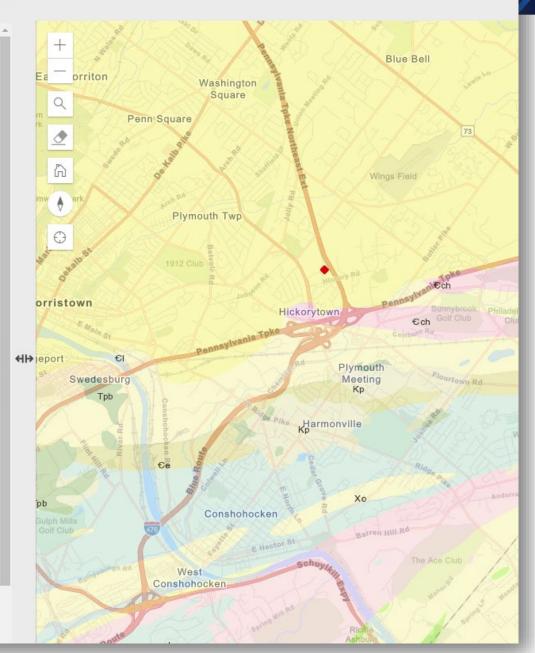
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오 Water Well	& Spri	ng Sea	arch		>
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9 Identify Re	sults				~
Latitude: Longitude: County: Municipality: Zip Code: Quadrangle:	40.120 -75.28 Montg Plymo 19462 Norris	250 omery uth			•
Geologic Units	5		1 of 1		~
Stockton	Forn	natio	n		
Geologic Age :		Triassic			
Map Symbol :		Trs			
Main Rock Type :		Arkosic Sandstone			
Bedrock Elevation :		162 -	254 Ft /	ASL	
The Stockton Newark basin to buff, coarse and red to pu siltstone, and	. It is co -graine rplish-r	mpose ed, arko ed san	d of ligi osic sand dstone,	ht-gr dstor shale	ray ne e,

beds are well developed. Its maximum

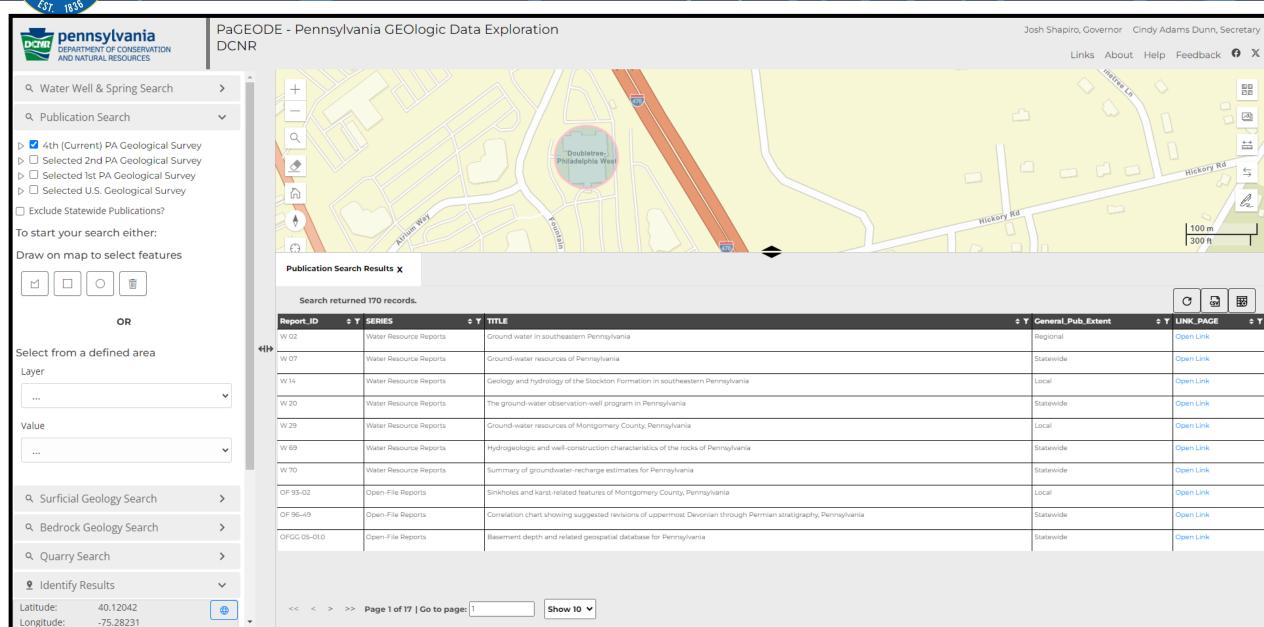
thickness is approximately 3,300 feet

(Geyer and Wilshusen, 1982).

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Publication Search



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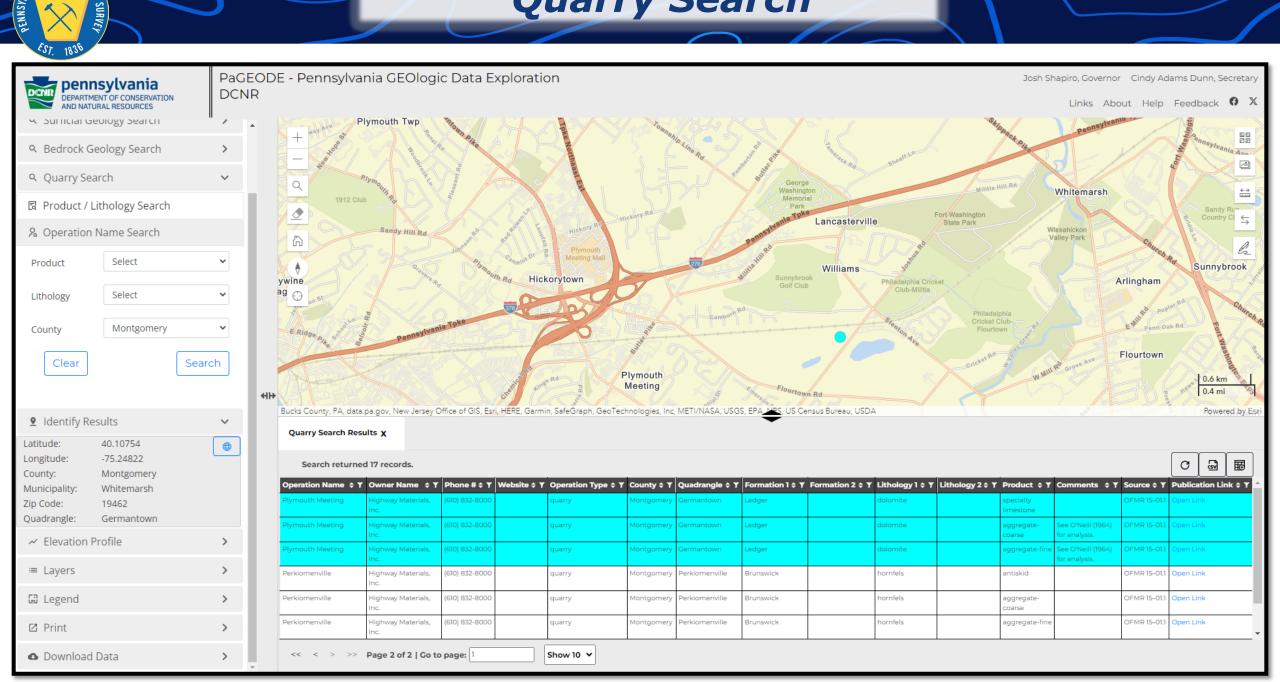
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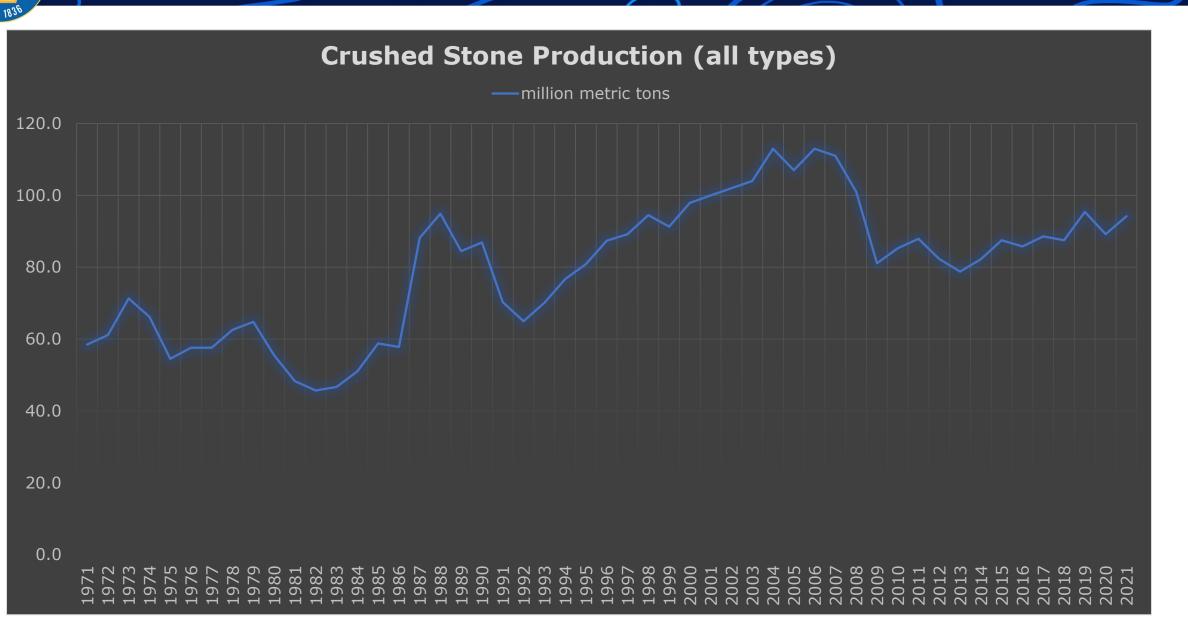
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Quarry Search

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Activities of the Survey Supporting the Future of the Aggregate Industry

- Ongoing search for funding for aggregate availability study
- Through the Association of American State Geologists, engaging with NSSGA, National Mining Association, and the Essential Minerals Association
- New maps, reports, data; working to make data more easily accessible
- Geologic Mapping Advisory Committee
 - PACA representative is Josie Gaskey
 - We welcome your input

PA Geologic Data Exploration

GEOLD

https://www.gis.dcnr.state.pa.us/pageode/

