

G PENNSYLVANIA O L O G Y



THE PENNSYLVANIA GEOLOGICAL SURVEY

VOL. 14/3

COMMONWEALTH OF PENNSYLVANIA

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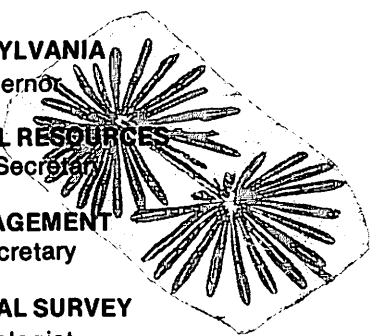
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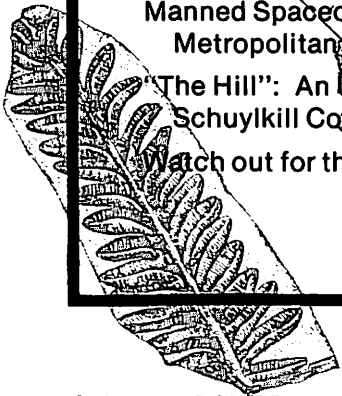
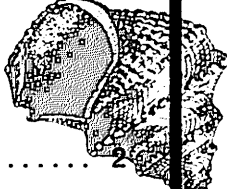
TOPOGRAPHIC AND GEOLOGICAL SURVEY

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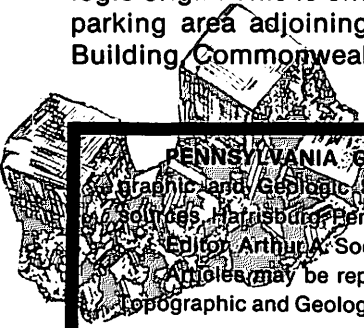


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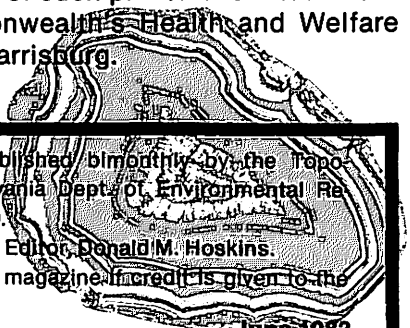
ON THE COVER: A stone planter cut from a single block of migmatitic granite; the texture of the stone reveals its complex geologic origin. This is one of a number of such planters located in the parking area adjoining the Commonwealth's Health and Welfare Building, Commonwealth Avenue, Harrisburg.



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June 1983

FROM THE DESK
OF THE
STATE GEOLOGIST . . .



GEOLOGISTS FACING THE ANGRY PUBLIC

Years ago geological work entailed basic mapping of the rock formations and mineral deposits with accompanying research to unravel the processes and conditions by which these earth resources were formed. Such endeavors constituted the stimulating, scientific activities in the wonderful world of geology.

Geologists today, particularly those in government service, have a broader scope of work responsibilities. Now we have to deal with the interrelationship of geology to societal activities and we are involved with issues such as suitable sites for hazardous waste disposal, evaluating the geologic safety of nuclear power plant locations, locating groundwater resources of sufficient quantity and quality suitable for public water supplies, assessing the geologic and hydrologic safety of proposed radioactive waste disposal sites, and determining whether certain potentially hazardous mineral constituents are present in our building materials (e.g. certain forms of asbestos) or our fuels (e.g. mercury or selenium).

Since these issues with which geologists are now involved deal with health and safety, there is a heavy responsibility upon the involved geologists to be particularly accurate and careful in their investigations. And because from the public standpoint these issues are matters of great concern, discussions over them become heated and highly emotional. Many geologists, therefore, long accustomed to dealing with rocks that don't talk back, are faced with the challenge of having their geologic findings face up to public scrutiny, including public doubts and hostility. This is an application of geology which is generally not taught in the colleges, yet it is extremely important, for it represents our geologic science at the interface with society's needs and concerns. It's not easy to face an angry, doubting audience of non-scientists and make a convincing presentation. But that's the challenge that many geologists must now be prepared to face.

Arthur G. Socolow

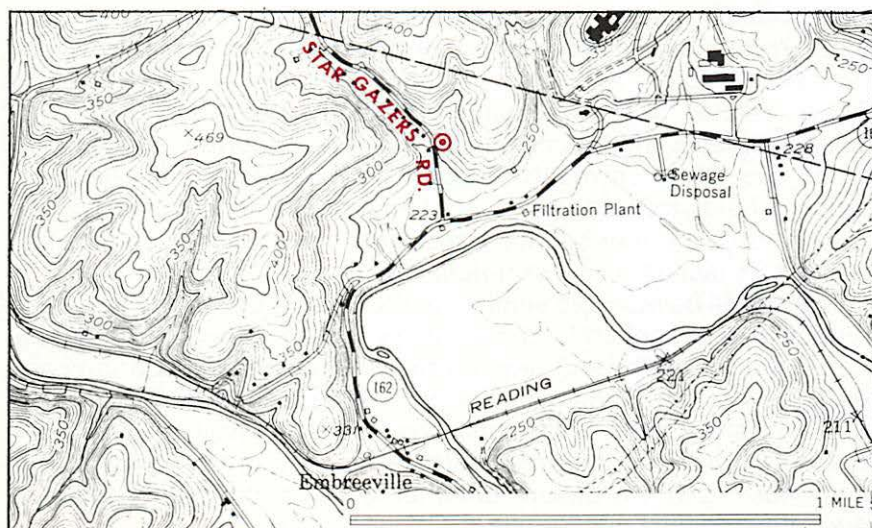
The Star-Gazers Stone

by Alan R. Geyer
Pennsylvania Geological Survey

In granting charters for America's colonies, the King of England often paid little attention to exact boundaries. One of the most famous boundary disputes arose between William Penn (Pennsylvania) and Lord Baltimore II (Maryland). They died still bickering over this dividing line. Their heirs resolved the problem by hiring a young astronomer named Charles and a surveyor/astronomer named Jeremiah.

In 1764, these two gentlemen had to use the stars to locate the southern tip of Philadelphia; the PA-MD boundary was then 15 miles due south. However, that would have been New Jersey, so they had to travel west to clear the Great Arc that formed the north boundary of Delaware. Their mission was to find a reference point due west of the southern tip of Philadelphia and 15 miles north of the PA-MD "boundary."





By March of 1764, with the use of their sensitive instruments, they found the spot. They marked this location with a large layer of vitreous quartzite, henceforth known as the Star-Gazers Stone. To the best of our knowledge this quartz layer came from a nearby exposure of the Setters Quartzite.

From the Star-Gazers Stone they cut a straight line 15 miles south to the exact point from which Charles Mason and Jeremiah Dixon surveyed Pennsylvania's southern boundary, the Maxon-Dixon Line.

The Star-Gazers Stone may be seen today along Star Gazers Road in Chester County near the village of Embreeville. From this stone, Mason and Dixon surveyed their way into American history.

Mineral Research Fund

In keeping with its primary goal of advancing the scientific understanding of mineralogy, the Pennsylvania Chapter of Friends of Mineralogy has created a Memorial Fund, monies from which will go to support research on the minerals of Pennsylvania. The Chapter will award grants ranging from \$50 to \$250 to eligible students from this fund as a tribute to past members and colleagues.

Full-time graduate and advanced undergraduate students in accredited colleges and universities throughout the United States and Canada may apply. Projects including both field and laboratory studies which characterize a mineral's composition, optical properties, density, crystallography, habit and paragenesis are encouraged. Problems in geochemistry, petrology, ore, microscopy, fluid-inclusion studies, and field mapping will also be considered if closely related to Pennsylvania mineralogy. Research within surrounding states will be considered if similar occurrences are likely within the Commonwealth. Support may be utilized for field expenses, field and laboratory equipment for the department, research supplies, thin sections, instrument fees, analyses or references purchased for an institutional library.

Grants will be awarded semi-annually on October 15 and February 15. Completed applications must be post-marked no later than one month before the award date. Further details and applications are available from Mr. Donald Schmerling, 1780 Prescott Road, York, PA 17403. It is the hope of the members of the Pennsylvania Chapter that in honoring its past members and friends in this manner, the Memorial Fund will ensure continuing research in Pennsylvania mineralogy to the benefit of all.

Is There a Fault in Our Gap?

by
Joseph P. Theisen

The grandeur and natural beauty of Susquehanna Gap, north of Harrisburg, Pennsylvania, has long attracted the attention of all who travelled northward from the Great Valley. The Gap is also of interest for the wealth of geologic information it provides. It is one of the few localities where the rocks of Blue Mountain may be seen in cross-section.

A new roadcut along U.S. Route 22-322 on the east side of the gap at Rockville provides a unique opportunity to compare the stratigraphy and structure on opposite sides of Susquehanna Gap and sheds light upon a possible structural control of the location of the gap. The rocks on the east side show more deformation and contain different rock types than the section on the opposite side of the gap. A pre-folding, strike-slip fault under the river in the Gap may explain these features.

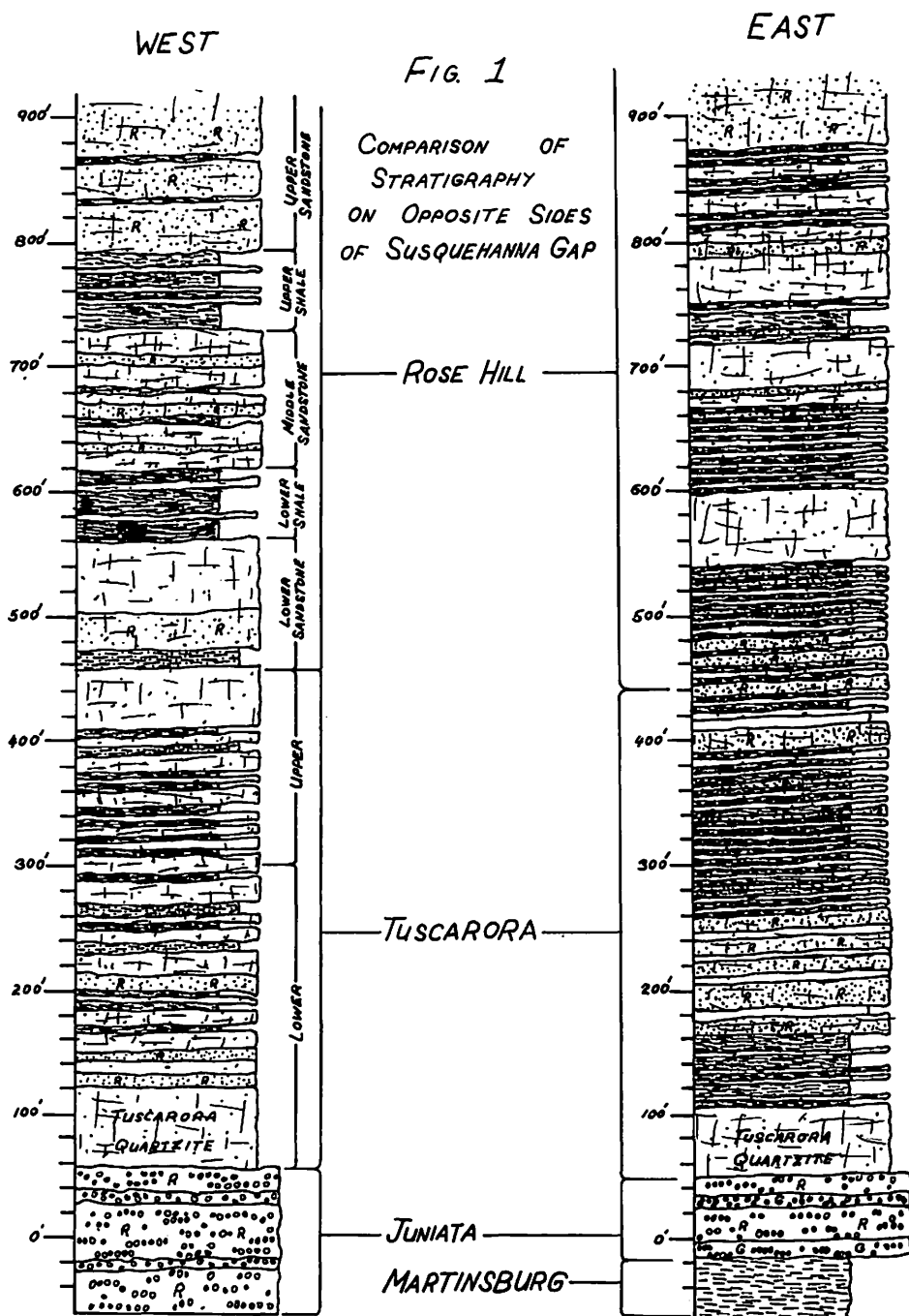
STRATIGRAPHY

The five formations in the Gap are, from bottom to top: Martinsburg (shale), Juniata (sandstone and conglomerate), Tuscarora (sandstone), Rose Hill (sandstone and shale), and Bloomsburg (sandstone and shale). Dyson (1967) identified distinctive subdivisions in the Tuscarora and Rose Hill Formations on the west side. The Tuscarora here consists of a lower unit of thickly bedded quartz sandstones with little shale, and an upper unit characterized by thinner beds and a greater amount of shale. Five subdivisions in the Rose Hill include two sixty-foot-thick shale zones which occur between resistant quartzitic and hematitic sandstones.

The Tuscarora is correlated across the Gap by the basal quartzite which can be found on both sides (Figure 1). With the exception of the basal quartzitic member of the Tuscarora, no other individual rock units persist across the Gap.

STRUCTURE

The rocks of the Susquehanna Gap are subvertical and those on the east side of the gap are more deformed than those on the opposite side. The western outcrop contains minor extension faults and abundant joints. Extensional faulting is also present in nearby exposures to the north in the Mahantango Formation exposures in Little Mountain (Cloos and Broedel, 1943).



Compressional features found in the highly strained rocks of the east side include wedge faults and kink bands (Figure 2). Intrabed wedge faults are very common, both singly and in conjugate sets; they occur at small angles to bedding and in places follow pre-existing planes such as cross-bedding surfaces (470' in Fig. 2). Thrust faults cutting through several beds and measuring up to 30 feet in displacement are less numerous (790' in Fig. 2). Trends of slickensides on these compressional faults are perpendicular to fault-bedding intersections, and when beds are rotated to horizontal, indicate a greatest principle stress in the plane of bedding. These low-angle reverse faults are therefore one of the earliest structures present.

Kink bands, which also occur singly and as conjugate sets, form conjugate, or "box" folds at their intersections (300' and 320' in Fig. 2). These conjugate kink structures are not symmetric to bedding implying that small-scale folding began after the start of major folding.

The most common extensional features are conjugate sets of faults which are oriented at 60° to 90° to bedding. One fault set, the dominant one, dips approximately 30°N, whereas the other is generally horizontal. Displacements on faults range upwards to 150 feet (660' in Fig. 2). Extension also occurs in the form of incipient boudinage (pinch and swell) (365' in Fig. 2). Both incipient boudinage and extensional faulting are extremely common in the outcrop. Since extension faults offset all other structures, they occurred late in the deformational sequence, post dating both the compressional reverse faults and the kink folding.

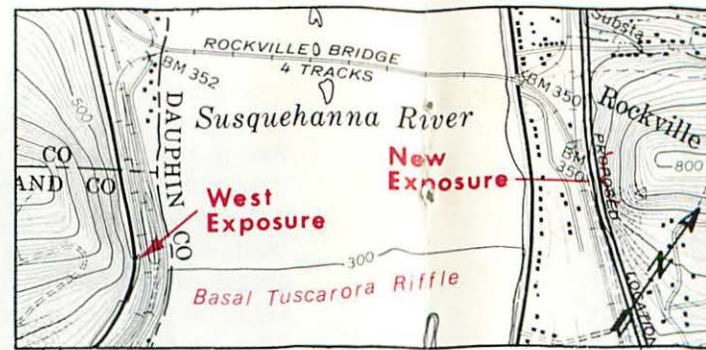
The Lower Tuscarora rocks at the southern end of the new outcrop are more highly strained than the rest of the exposure. This increased strain appears to result from a thrust fault which has moved the Martinsburg over the Juniata and brought it into contact with the basal quartzitic member of the Tuscarora (0'-50' in Fig. 2). The orientation and sense of movement of the thrust fault imply that it occurred late in the deformational sequence during the last stages of folding. The thrust fault is not offset by extensional faults, also indicating that it is a late feature.

POSSIBLE ORIGIN OF SUSQUEHANNA GAP

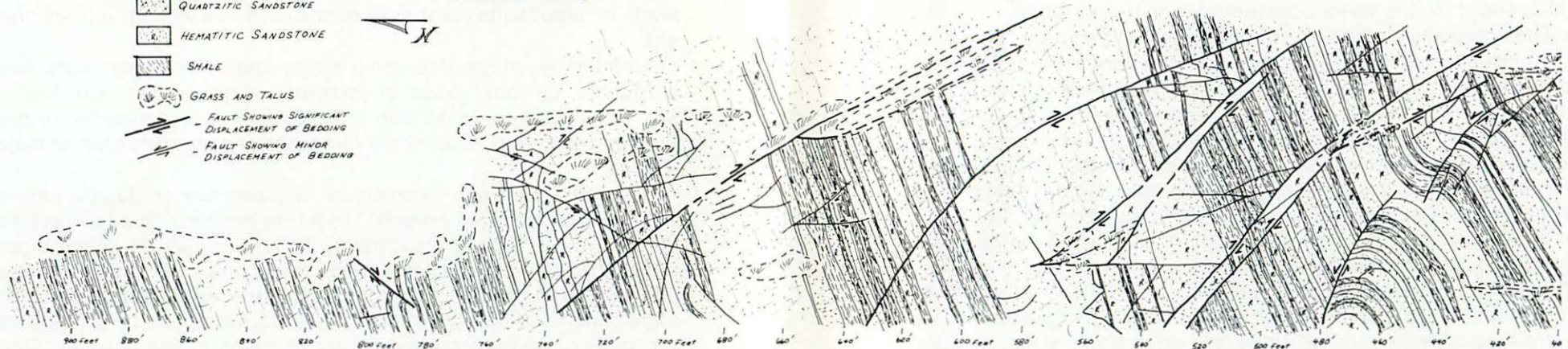
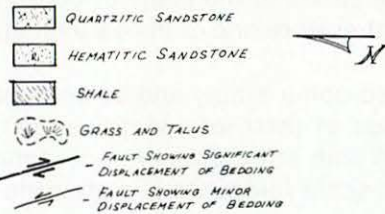
Major water gaps generally imply zones of weakness in the rocks through which drainage developed. Studies of Cumberland Gap (Rich, 1933) in western Virginia and of the Delaware Water Gap (Epstein, 1966) in eastern Pennsylvania describe offset of ridges caused by differing bedding dips on opposite sides of the gaps and

FIG. 2 GEOLOGIC DIAGRAM
OF THE EAST SIDE
OF SUSQUEHANNA GAP

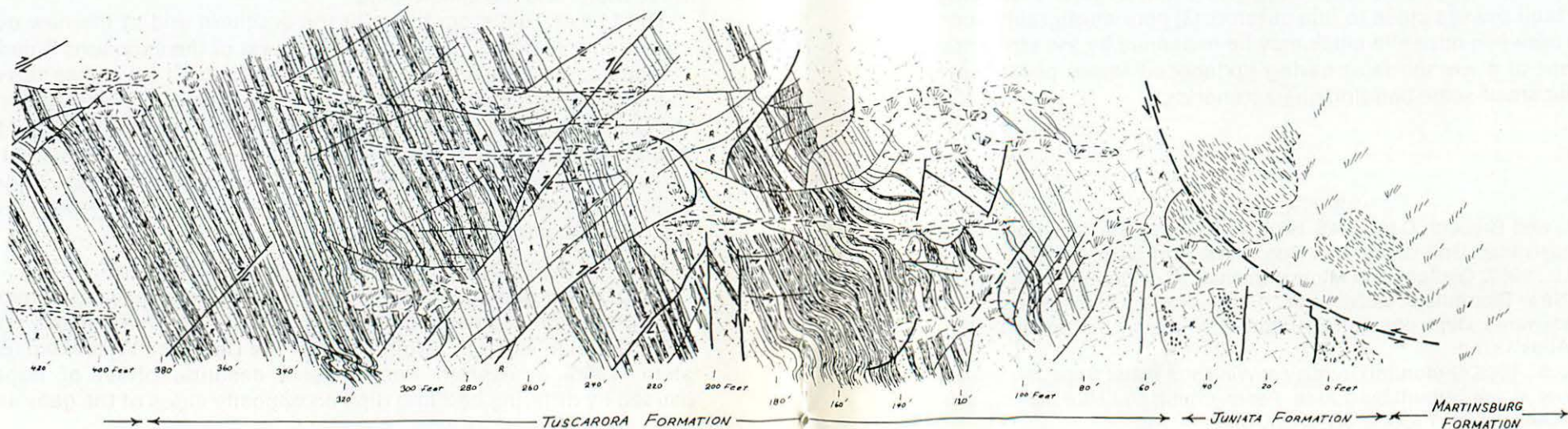
(OUTCROP APPEARS AS SEEN FROM BELOW)



Index Map



ROSE HILL FORMATION



suggest that post- or synfolding, transverse or strike faults are responsible for the location of the gaps.

At Susquehanna Gap, however, bedding dips are identical on opposite sides and therefore it is unlikely that a large-displacement, late-stage fault is responsible for Susquehanna Gap. The structure which controlled the location of the Gap is possibly a prefolding wrench fault. Such a fault, caused by shear between independently advancing thrust blocks, would correspond to the prefolding, small-scale wrench faults described by Nickelsen (1979) in the sequence of deformation at the Bear Valley Strip Mine.

The presence of a prefolding wrench fault in Susquehanna Gap could account for the various features found in and adjacent to the Gap. The unusually high degree of deformation seen only in the new outcrop could result from a narrow wrench zone cutting obliquely through the wide gap, closer to the east side than the west. Air photos show the riffle in the Susquehanna River (Figure 1, index map) caused by the resistant basal Tuscarora quartzite apparently undeformed. The riffle ends abruptly as it approaches the east bank where the river flows on alluvium. The area between the east end of the riffle and the gap outcrop could contain a wrench (tear) fault.

In summary, the interpretation that a prefolding, large-scale wrench fault caused the structural weakness that controlled Susquehanna Gap is based on the following: (1) no offset of ridges is seen across the gap, hence the structure causing the gap cannot be a postfolding wrench fault; (2) while late extensional structures are found at all nearby exposures, prefolding compressive deformation (wedges, thrusts, and kink folds) occurs only in the rocks on the east side of Susquehanna Gap, suggesting that a major prefolding wrench fault passes close to this outcrop; (3) poor stratigraphic correlation between opposite sides may be explained by the strike-slip movement of a wrench fault having juxtaposed facies possessing dissimilar small-scale bedding characteristics.

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MANNED SPACECRAFT PHOTOGRAPHS AND MAJOR METROPOLITAN AREA PHOTOGRAPHS

Views of the earth obtained from spacecraft provide large amounts of information about our planet, its resources and its inhabitants. Spacecraft aerial data are being used in: land-use planning, agriculture, forestry, geography, geology, hydrology and range management. Sophisticated techniques are used to obtain high altitude photography. High-flying aircraft operated by NASA flies specific areas while Landsat satellite circles the earth in a changing orbit.

SATELLITE IMAGES AND PHOTOGRAPHS

Satellite images available are the result of the NASA program established in 1972. A limited number of space photographs come from the Gemini and Apollo programs (1965 to 1970) and from the Skylab program (1973 to 1974). The photographic coverage of the Gemini and Apollo programs was limited by the flight paths of the aircraft. These pictures generally cover the southwest, the Gulf Coast and Florida. The Skylab program was designed to obtain photographic coverage of the Earth between latitudes 50° North and South. During the three Skylab flights more than 35,000 frames of photography were acquired. Coverage included most of the conterminous United States, a large part of South America, and parts of Africa, Europe, and the Middle East. The largest group of photographs available is from the Landsat Program. Landsat circles the Earth 14 times daily. From an orbital altitude of 570 miles it provides repetitive coverage every 18 days.

AVAILABLE PRODUCTS

MANNED SPACECRAFT PHOTOGRAPHY-The photographs acquired during the Gemini, Apollo and Skylab series of spacecraft programs are useful in planning, agriculture, geographic and other studies and for general viewing. The spacecraft photography can be ordered by contacting the Eastern NCIC office, and requesting two forms: Manned Spacecraft Photograph Order Form and Geographic Search Inquiry Form.

METROPOLITAN AREA PHOTOGRAPHS-Prints of color and color-infrared photographs of more than 100 cities in the United States are available. They were chosen from NASA aircraft, Skylab spacecraft and Landsat satellite coverage. The photographs and images are useful for regional planning and general viewing. NASA aircraft photographs provide the most terrain detail. Skylab photographs offer the next greatest level, and Landsat imagery the least amount of detail. Print sizes range from a 4.5-inch square Skylab print to a 36-inch square NASA aerial photographs. These prints may be ordered by contacting: Eastern Mapping Center-NCIC, U.S. Geological Survey, 536 National Center, Reston, VA 22092. Telephone: 703-860-6336.

"The Hill": An Unusual Glacial Feature In Schuylkill County

by

Duane D. Braun and Keith Springman
Geography and Earth Science Department
Bloomsburg State College

"The Hill" is a till-capped sand deposit located 1.7 mi northwest of Ringtown (west of Mahanoy City) on the north side of legislative route 53064 (northeast portion of Ashland 7½' quadrangle) (Fig. 1). The deposit forms a knob that projects from the flank of Little Mountain into the valley of Trexler Run and lies 1.6 mi northeast of a low col that marks the drainage divide with Roaring Creek. Trexler Run, which makes a broad loop around "The Hill" has been dis-

placed southward by the deposit where it has cut a relatively narrow, steep walled channel 40 feet into bedrock. The sand is mined by the owner, Daniel Grow of Ringtown.

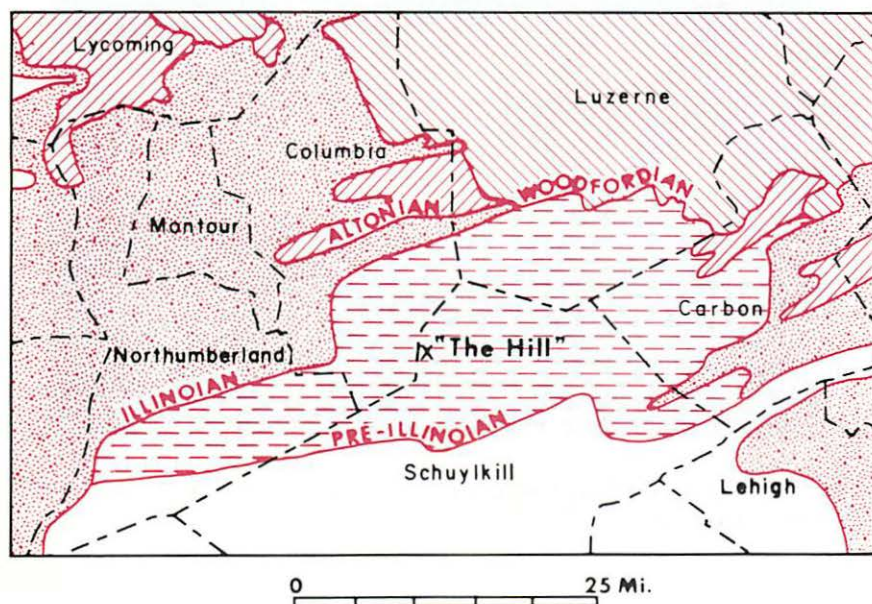


Figure 1. Map showing extent and age of glacial deposits in east central Pennsylvania. Woodfordian, Altonian, and Illinoian areas taken from 1980 Geologic Map of Pennsylvania. Pre-Illinoian area is from Leverett (1934).

The deposit comprises 3 to 6 ft of bouldery diamicton (till) overlying 33 to 36 ft of sand (Fig. 2). The diamicton is a moderately cohesive and unsorted mixture of clay to boulder-sized material. The matrix between clasts tends to be silty or sandy and is reddish brown in color, reflecting its derivation from the underlying red shale and sandstone of the Mauch Chunk Formation. Pebble-sized and larger clasts are angular to well rounded, commonly striated, and relatively unweathered to moderately weathered with weathering rinds a few millimeters thick. The larger clasts are dominantly sandstone and conglomerate derived from the Mauch Chunk, Pocono, and Pottsville Formations.

The sands are medium to very fine grained, yellowish brown and well stratified with prominent ripples, climbing ripples, and cross bedding. Anthracite grains form dark laminae and are also present as scattered pebble-sized and larger fragments. The upper 3 to 6 ft



Figure 2. Till overlying kame delta sands; Little Mountain forms skyline.

of sand have been oxidized to a reddish yellow to black color. A few small-scale normal faults and reverse faults of a few millimeters to centimeter displacement are present. The fine-grained sands immediately under the diamicton are deformed into a series of folds or convolutions by unequal loading (load casting) of the diamicton upon the sands. Clast-rich portions of the diamicton tend to protrude downward into the underlying fine to very fine grained sands, in places producing vertical isoclinal folds in the sands.

"The Hill" is interpreted to be part of a kame delta that was deposited in a proglacial lake that formed when advancing ice blocked Trexler Run's eastward flow (Fig. 3). The lake spilled westward, as suggested by the attitude of the cross bedding, across a low col at an elevation of about 1200 ft into the Roaring Creek drainage (Fig. 3). The lack of coarse sand and larger grain sizes, the horizontality of the bedding, the presence of climbing ripples, and the fact that the top of the sand is 50 ft below the spillway elevation, indicate that the sands are probably the bottomsets at the distal edge of an originally much larger kame delta. A few rounded masses of diamicton as much as 1.5 ft in diameter occur within the upper 6 ft of the sands. The deformation of bedding beneath these masses suggests that they were dropped from ice rafts floating on the lake surface.

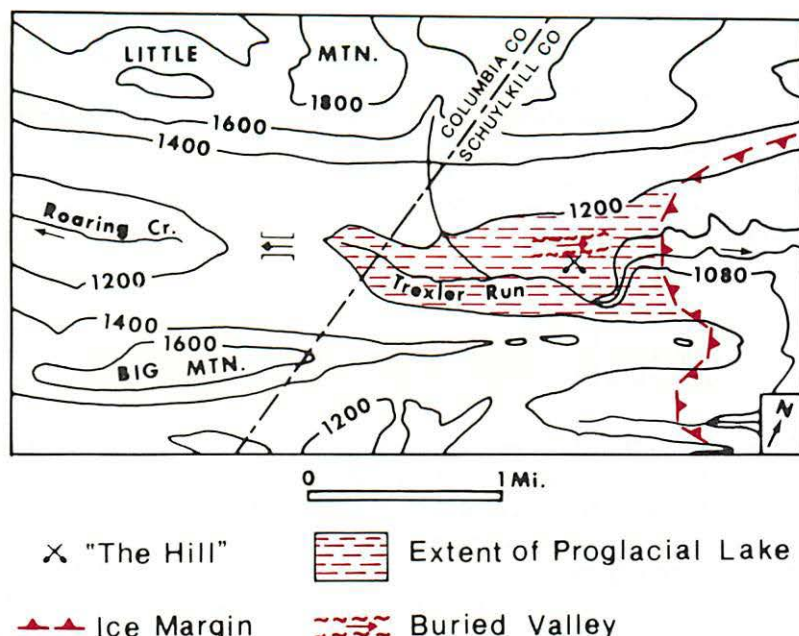


Figure 3. Map showing the position of the ice margin and the proglacial lake at the time the kame delta was being deposited.

The diamicton overlying the sands may have been deposited (1) directly from glacier ice that overrode the delta, (2) as a subaqueous debris flow from the nearby edge of the glacier, or (3) from basal melting of overriding but floating glacier ice. There is no conclusive evidence to prove or disprove any of these alternatives, but deposition directly from the glacier seems most probable.

This deposit lies beyond the limits of glaciation shown on the 1980 Geologic Map of Pennsylvania, but was included in an area of pre-Illinoian drift by Leverett (1934) (Fig. 1). The degree of weathering and soil development in the diamicton is similar to that of the Glen Brook till (Inners, 1981) which is considered early Wisconsinan (Altonian) in age. In contrast, the amount of erosion of the deposit, the deep incision of translocated Trexler Run, and the lack of other glacial deposits for several miles around the site are facts more consistent with an Illinoian age. More study is required before an age assignment can be made with confidence.

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Watch out for the Creep

Zone of weathered gneiss showing effects of slow, down-slope movement due to gravity, a phenomenon known as creep. Where movement of weathered zone directly above the bedrock is minimal, the banding is vertical; where movement has been pronounced, the banding is nearly horizontal. The topographic slope is 4:1 or less than 15° . Such differential movement suggests the need for caution in planning foundations and interpreting geochemical soil surveys. The shovel in the photo is about 3 feet in length.





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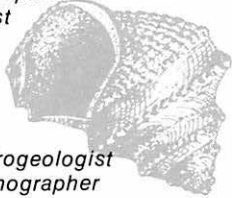
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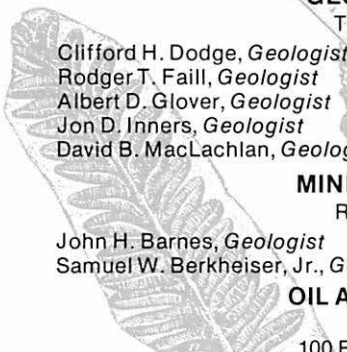
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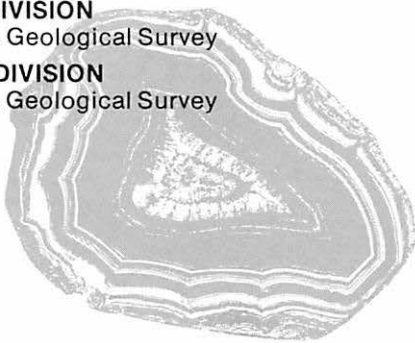
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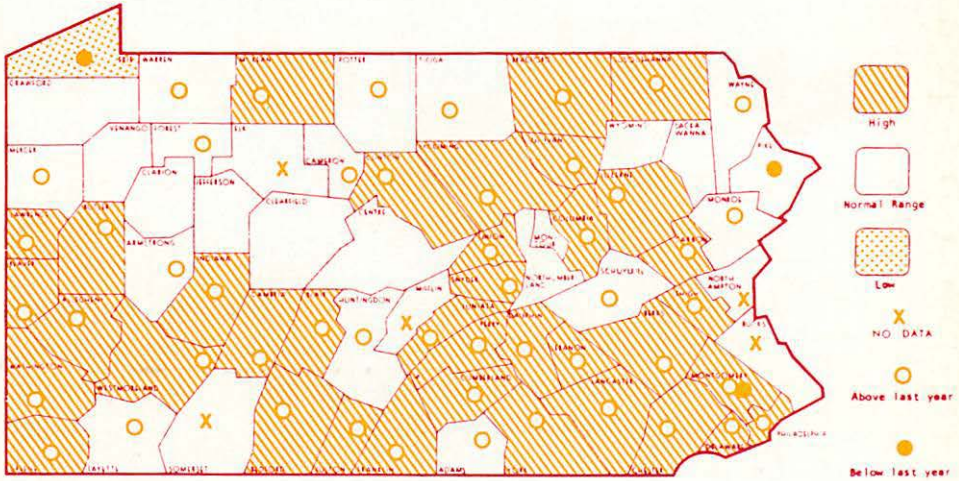
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