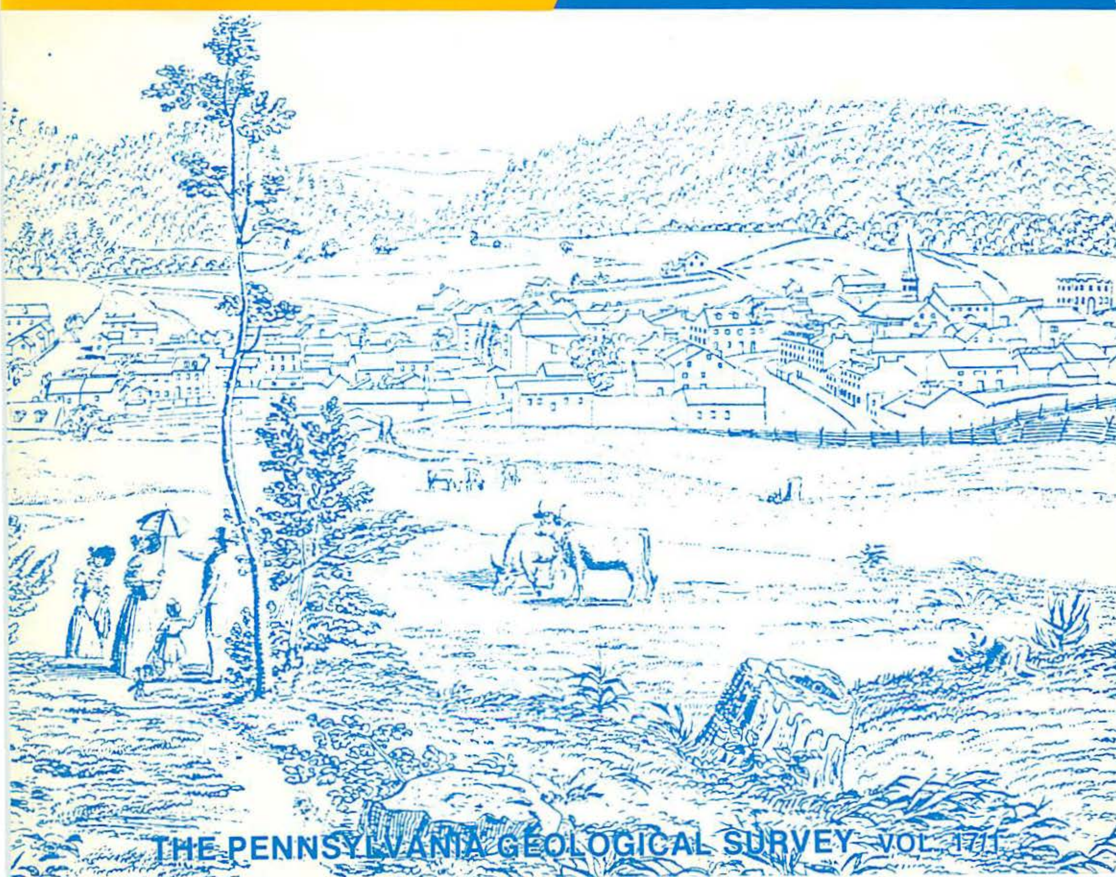
# PENNSYLVANIA GEOLOGY

PENNSYLVANIA GEOLOGICAL SURVEY
150TH ANNIVERSARY
1836 - 1986





THE PENNSYLVANIA GEOLOGICAL SURVEY VOL. 17/1

**COMMONWEALTH OF PENNSYLVANIA**
Dick Thornburgh, Governor

**DEPARTMENT OF ENVIRONMENTAL RESOURCES**
Nicholas DeBenedictis, Secretary

**OFFICE OF RESOURCES MANAGEMENT**
Patrick J. Solano, Deputy Secretary

**TOPOGRAPHIC AND GEOLOGIC SURVEY**
Arthur A. Socolow, State Geologist

## CONTENTS



**ON THE COVER:** Reproduction of copper plate lithograph of Bellefonte, Centre County, sketched by George Lehman, an artist employed by Henry D. Rogers in the 1840's to illustrate *The Geology of Pennsylvania, a Government Survey*, published in Philadelphia, Pa. in 1858.

**PENNSYLVANIA GEOLOGY** is published bimonthly by the Topographic and Geologic Survey, Pennsylvania Dept. of Environmental Resources, Harrisburg, Pennsylvania, 17120.

Editor, Arthur A. Socolow; Associate Editor, Donald M. Hoskins.



**VOL. 17, NO. 1** **FEBRUARY 1986**

## FROM THE DESK OF THE STATE GEOLOGIST

### The Pennsylvania Geological Survey Celebrates 150 Years

On March 29, 1836, the Pennsylvania Legislature passed an act which provided for a "Geological and Mineralogical Survey" of the State. Thus, we are celebrating this year the 150th Anniversary of the founding of the Pennsylvania Geological Survey, one of the first state geological surveys in the Nation and one of the oldest agencies in Pennsylvania State Government.

When first authorized, it was contemplated that a geologic survey of the State could be completed and be done with in 10 years. Under the direction of the distinguished Henry Darwin Rogers, after outstanding, perceptive field work and handicapped by lapses in appropriations, a magnificent, two volume, illustrated geologic report of 1631 pages, accompanied by a state geologic map, was issued in 1858. Combining astute scientific observations with romantic prose, that first report provided a comprehensive summary of the geologic framework of Pennsylvania as then understood.

After a hiatus of 16 years, the Second Geological Survey of Pennsylvania was authorized in 1874. J. Peter Lesley served as the Second State Geologist and his staff included such outstanding geologic contributors as C. A. Ashburner, J. F. Carll, E. V. D'Invilliers, F. A. Genth, T. S. Hunt, A. S. McCreath, and I. C. White. By 1887 geologists of the Second Survey had mapped the state in great detail, recording not only the stratigraphy and structure, but placing emphasis upon the burgeoning mineral industry, then the most active in the country. 81 volumes, 35 comprehensive atlases, a grand atlas of county geologic maps, and a new state geologic map (1893) were issued by this distinguished, highly productive staff.

In 1909, after a lapse of some 20 years, the Legislature again authorized a "Topographic and Geologic Survey Commission", with instructions to cooperate with the newly formed U.S. Geological Survey. With Richard R. Hice as the State Geologist, the Third Survey emphasized mineral resource studies in the 17 volumes of geologic reports it issued before its demise in 1914.

Our present Topographic and Geologic Survey, the Fourth Survey, was legislatively mandated in June of 1919. It has been in continuous service since that date, in recognition that the needs for geologic investigations and geologic services are never-ending, and in fact, ever changing. Over the years our Survey has functioned under the Department of Internal Affairs, Department of Forest and Waters, State Planning Board, and since 1971, the Department of Environmental Resources. George H. Ashley served as State Geologist from 1919 to 1946; his geologic insight and achievements, particularly his contributions to coal geology, earned national acclaim. Ashley was succeeded briefly as State Geologist by Ralph Stone; Stanley Cathcart served from 1947 to 1953, Carlyle Gray from 1953 to 1961, and Arthur Socolow from 1961 to the present.

The four Divisions of the Topographic and Geologic Survey (Geologic Mapping, Mineral Resources, Environmental Geology, and Oil and Gas Geology) reflect both the diversity and specialization which are necessary to serve today's varied demands for geologic data and services. The diversity of the Survey's activities is further reflected in over 600 geologic publications and maps which the Fourth Geological Survey has issued over the years. These comprehensive geologic reports are issued under the categories of Atlases, County Reports, General Geology, Environmental Geology, Information Circulars, Mineral Resources, Water Resources, Maps, and State Geologic Map. The latter was completely revised in 1931, 1960, and 1980 to reflect the progress in mapping and new interpretations. A published Educational Series represents the Survey's recognition that geology is also of interest and use to non-technical persons, including students and recreationists. The 46 members of the Survey, including 28 highly trained geologists, are widely recognized for the quality and scope of their contributions. Their detailed geologic work and creative interpretations have served the Pennsylvania Geologic Survey to be recognized amongst the leading Surveys of the Nation.

On the occasion of its 150th Anniversary, the Pennsylvania Geological Survey is proud of its heritage and of its tradition of achievements and services to the Commonwealth and to the geological profession.

Arthur A. Socolow

## Franklin County Rock and Mineral Show

The Franklin County Rock and Mineral Club will sponsor their Ninth Annual Show on March 22-23, 1986, at the Chambersburg Middle School, Chambersburg, Pennsylvania. Show hours on the 22nd are 10:00 a.m. - 7:00 p.m.; on the 23rd they are 11:00 a.m. - 5:00 p.m. Lectures and demonstrations will be held during the show, as well as a variety of exhibited displays. For more information, contact Pat Hoyer, 6528 Mountain Dr., Chambersburg, PA 17201, telephone (717) 352-8548.

# A Sesquicentennial Story*
# EARLY MILLSTONE QUARRY IN TIOGA COUNTY

by Thomas M. Berg

A unique opportunity exists in Tioga County for our readers who are interested in the early development of mining and quarrying activities in Pennsylvania. A very old stone quarry from which millstones were once produced occurs in the upland countryside of Tioga State Forest northwest of Asaph (approximately six miles due west of Wellsboro). To find the site (Figure 1), turn north off U.S. Route 6 at the village of Asaph, and follow the Asaph Run road 3.1 miles toward the northwest to the Asaph Run Picnic Area where the road forks. Follow the right branch of Asaph Road, ascending the valley toward Bear Wallow, for 2.5 miles to another fork in the road. Follow the right branch for about 0.3 mile to "Hesselgessel Road" (a dirt road) which leads into the forest on the right. Follow this back road through the forest for 0.5 mile. The old quarry (Figure 2) is on the right (to the west).

The unique feature which makes a visit here worthwhile is a nearly complete millstone which was left behind after the quarry was abandoned. The millstone is lying in the southern part of the quarry area and is partly covered by the forest undergrowth (Figure 3). The millstone was cut by James Hesselgessel in 1836. Other stones for grist mills produced at this quarry were used at the Beach Mill at Little Marsh, Pa., the Billings Mill at Knoxville, Pa., and the Ainsley Mill at Galeton, Pa. The total number of stones produced here is unknown.

The Hesselgessel millstone was cut from the Olean Conglomerate near the base of the Pottsville Group. This conglomerate is a rock produced from sediment deposited by braided rivers during the Pennsylvanian Period approximately 325 million years ago. The rivers flowed toward the center of the slowly subsiding Appalachian Basin from a northern source area, probably southern Canada (Meckel, 1967). The materials deposited by these ancient rivers across north-central Pennsylvania comprised relatively clean, texturally mature, quartz sand and gravel. These sediments were ultimately buried and cemented together (mostly by secondary silica) to form hard, resis-

*Celebrating 150 years of The Pennsylvania Geological Survey—1836 to 1986.

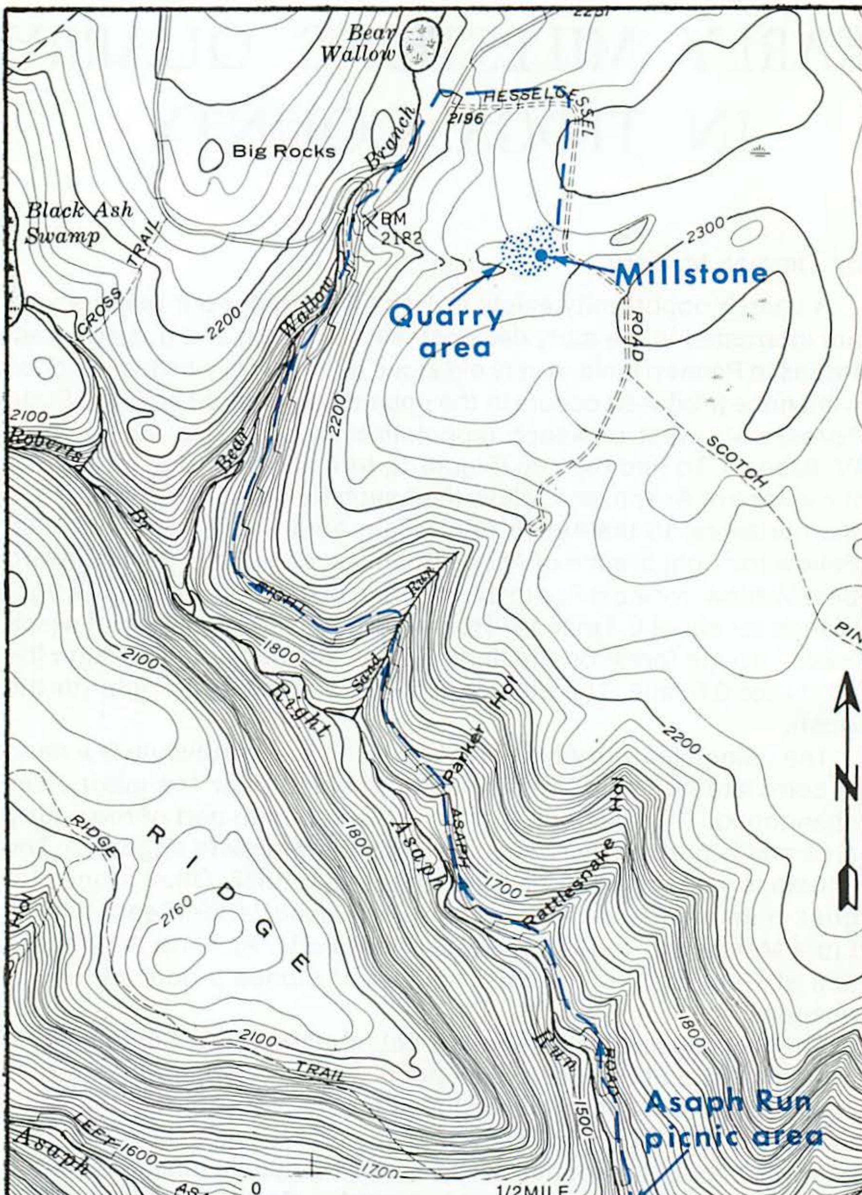



Figure 1. Location of the Hesselgessel millstone quarry in the Asaph Run area of Tioga County.

Figure 2. Hesselgessel millstone quarry. Exposures of Olean Conglomerate from which the millstones were cut are partly covered by dense vegetation.

Figure 3. The Hesselgessel millstone. Hammer for scale is about 1 foot long.

Figure 4. Close-up view of Olean Conglomerate at Hesselgessel quarry. Note size, shape, and abundance of quartz pebbles. Hammer gives scale.

tant layers of conglomerate (Figure 4) and quartzose sandstone. Erosion of these resistant rock layers has produced prominent low cliffs, benches, and "rock cities" that are quite distinctive on aerial photographs.

When the Hesselgessel millstone was cut in 1836, the Pennsylvania Geological Survey was in its first year. The names applied to these massive conglomerates and sandstones by geologists in those early days included "Formation XII," the "Seral conglomerate," and the "Millstone Grit." The latter name originated in England where rocks of the same approximate geologic age were also used for millstones] The present-day name "Olean" derives from similar prominent outcrops at "Rock City" south of Olean, New York. The "Pottsville Group" takes its name from the vicinity of Pottsville, Pa., where rocks of the same age and relative stratigraphic position are exposed.

There are other points of interest in the millstone area. About one mile west of the quarry is Black Ash Swamp State Forest Natural Area (Figure 1). Black Ash Swamp is a mountain bog wetland created in part by beavers. Visitors will see typical northern hardwood forest species including birch, beech, maple, cherry, and white ash. No black ash have been observed. An active beaver colony may be seen at Bear Wallow (Figure 1). Other wildlife include deer, bear, turkeys, and some rattlesnakes. Be cautious of rattlesnakes in the quarry area.

Enjoy your visit to this historic and beautiful part of Tioga County, and remember to leave it as you found it!

## References

Berg, T. M., and Dodge, C. M., compilers and editors (1981), *Atlas of preliminary geologic quadrangle maps of Pennsylvania,* Pennsylvania Geological Survey, 4th ser., Map 61, 636 p.

Meckel, L. D. (1967), *Origin of Pottsville conglomerates (Pennsylvanian) in the Central Appalachians,* Geological Society of America Bulletin, v. 78, p. 223–258.

# CAVES OF LEHIGH COUNTY, PENNSYLVANIA

Caves of Lehigh County is the newest addition to the MAR Bulletins from the Mid-Appalachian Region of the National Speleological Society. Twenty-five known caves in Lehigh County are listed. A description is included for each cave and, where possible, a map. Of the 25 known caves, 17 are closed or otherwise inaccessible. Seven of the accessible caves are on private land and permission must be obtained before entering.

Similar information is also available for Huntingdon, Snyder, Centre, Mifflin, Perry, Bucks and Lehigh Counties.

These publications are available from Bette White, 542 Glenn Road, State College, PA 16803.

## MID-APPALACHIAN REGION BULLETINS AVAILABLE

| | | | |
|---|---|---|---|
| #9 | Caves of Huntingdon Co., Pa. | 40 caves | $2.75 + postage* |
| #10 | Caves of Snyder Co., Pa. | 20 caves | 1.25 + postage* |
| #11 | Caves of Centre Co., Pa. | 71 caves | 4.75 + postage* |
| #12 | Caves of Mifflin Co., Pa. | 47 caves | 5.50 + $1.00 postage |
| #13 | Caves of Perry Co., Pa. | 13 caves | 1.50 + postage* |
| #14 | Caves of Bucks Co., Pa. | 24 caves | 3.00 + postage* |
| #15 | Caves of Lehigh Co., Pa. | 25 caves | 3.25 + postage* |

*Postage: 75¢ for first copy; 25¢ each additional to same address. Please make checks payable to M.A.R.

# The West Liberty Esker

by Gary M. Fleeger
Denver, Colorado

The West Liberty Esker (Figure 1) was deposited during the Kent deglaciation about 23,000 years ago. It occurs in three segments over a distance of 6½ miles between Harlansburg, Lawrence County, and West Liberty, Butler County, separated by post-glacial erosion by Slippery Rock Creek and Taylor Run. The northwestern, upstream segment consists of several short eskers that appear to form a tributary pattern with the main esker. The southeastern segment ends at a kame delta that was deposited in a proglacial lake. The esker is com-

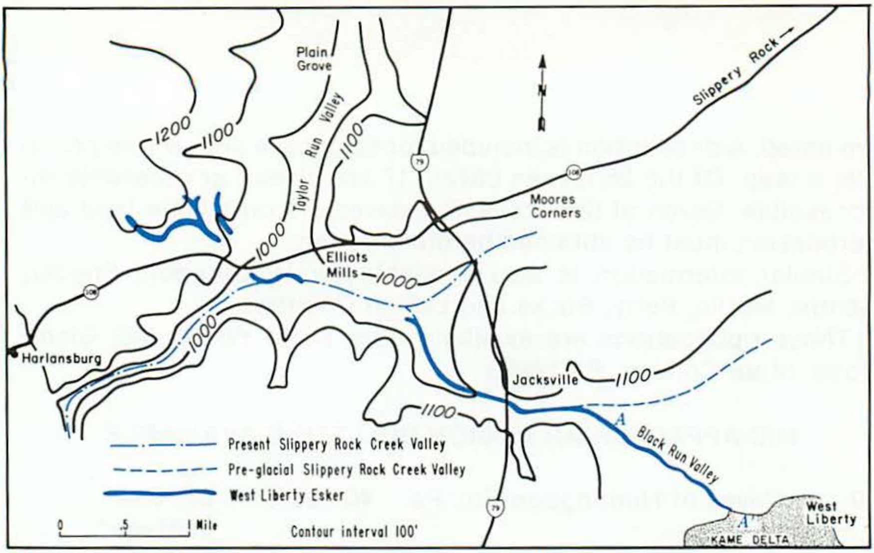



**Figure 1. Bedrock contour map (from Poth, 1963) showing location of West Liberty Esker.**

posed of cobbles, gravel, and sand, with grain size generally increasing downstream. Till caps the esker sediment in some places, while glaciofluvial gravels are present to the top in other sections. Delliquadri (1951) reported pebble lithologies of predominantly granite, gneiss, sandstone, and quartzite.

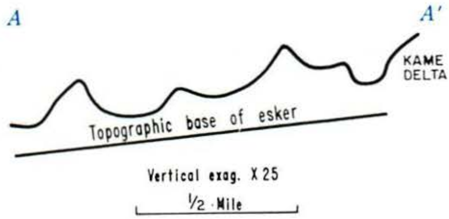
Eskers were once assumed to have been deposited only by streams flowing through subglacial meltwater tunnels. However, they can also be deposited in englacial tunnels, open supraglacial channels, or at the glacier front where a meltwater channel or tunnel emerges. A close look at the structure and morphology indicates that the West Liberty Esker was deposited at both subglacial and ice frontal positions.

Evidence that the esker was deposited in a tunnel is the downstream increase in elevation of the base of the esker, from 1100 feet at Slippery Rock Creek to 1215 feet at the kame delta. Water can flow uphill only when a sufficient hydrostatic head is developed in a full flowing tunnel because of the greater thickness of the overlying ice upstream than downstream. An esker extending uphill can also result from the lowering of an englacial tunnel esker or a supraglacial channel esker during melting of the supporting ice, or a time transgressive esker deposited at the ice front as the glacier retreated downhill (Banarjee and McDonald, 1975). There is no deformation of the entire esker to indicate melting of supporting ice. Extensive faulting only along the edges (Geyer and Bolles, 1979), because of slope failure during the melting of the ice walls, indicates that the West Liberty Esker was deposited in a subglacial tunnel, and not at an englacial, supraglacial, or ice front position. Some ice front deposition did occur, but is not the main location of deposition.

Another indication that the esker was deposited in a subglacial tunnel is that most of it follows the buried, preglacial valleys of Slippery Rock Creek and Black Run (Figure 1). This can happen only if the tunnel is at the base of the glacier, in contact with the land surface (Banarjee and McDonald, 1975).

The morphology of the West Liberty Esker also gives an indication of the character of the Kent glacier. The esker is sinuous in the upstream part, but changes southeast of Jacksville, where it has angular bends and parallel straight segments. This is due to differences in ice thickness. At depths greater than 100 feet in a glacier, the overlying weight causes the ice to behave plastically (Sugden and John, 1976) so that crevasses will not extend into the glacier more than about 100 feet. Subglacial tunnels follow fractures in the ice where they reach the base of the glacier (Stenborg, 1968), suggesting that the Kent glacier was 100 feet thick or less near its terminus when the straight esker segments were deposited. A very thin glacier is consistent with the thin, discontinuous Kent Till in northeastern Ohio and northwestern Pennsylvania.

**Figure 2. Profile along downstream portion of West Liberty Esker between locations A and A' shown on Figure 1.**




The esker southeast of Jacksville has higher mounds, or beads, at 1700 foot intervals (Figure 2). Increased summer meltwater discharge may have deposited greater amounts of sediment on top of the subglacial tunnel esker at the tunnel mouth as the ice front melted back. This would indicate that the initial rate of annual retreat of the Kent glacier was 1700 feet.

## REFERENCES

Banarjee, I. and B. C. McDonald (1975) Nature of esker sedimentation *in* Glaciofluvial and glaciolacustrine sedimentation, A. V. Jopling and B. C. McDonald, eds., SEPM Special Publication 23, pp. 132-154.

Delliquadri, L. M. (1951) Physiography and history of glacial Lake Arthur, unpublished M.S., thesis, Clark University, 66 p.

Geyer, A. R. and W. M. Bolles (1979) Outstanding scenic geologic features of Pennsylvania, Pennsylvania Geological Survey, 4th series, Environ. Geol. Rept. 7, 508 p.

Poth, C. W. (1963) Geology and hydrology of the Mercer quadrangle, Pennsylvania Geological Survey, 4th series, Water Resource Report 16, 149 p.

Stenborg, T. (1969) Studies of internal drainage of glaciers, Geogr. Annlr., v. 51 A, pp. 13-41.

Sugden, D. E. and B. S. John (1976) Glaciers and landscape, Halstead Press, 376 p.

# Building Stones From Cumberland County

Caretti, Inc., a Cumberland County masonry contractor, controls the last known active limestone quarry used solely as a source of building stone in Pennsylvania. It has long provided quarry-run and ashlar blocks for buildings such as at Dickinson College and Pennsylvania Turnpike Service Areas. The Carlisle area is underlain by carbonates that were early recognized by pioneers as valuable assets. In 1753, John O'Neal, Esq., wrote to Governor Hamilton, "A lime kiln stands on the centre square, near what is called the deep quarry, from which is obtained good building stone." (Rupp, 1846, p. 389). It was then considered favorable and a status symbol to have a quarry in the center of town. Furthermore, according to the 1840 county census, of the 67 houses built, 49% were of brick and stone (Rupp, 1846).

The Caretti Quarry is located in West Pennsboro Township about 0.8 miles NW of Plainfield, Pennsylvania, near the south bank of the Conodoguinet Creek. Here, since after the turn of the century, three generations of Morrisons have worked this quarry by hand (Figure 1). Paul W. Morrison lives nearby and is the retired quarry foreman. Dante Caretti and his son, Sam, bought this quarry as a captive source of local building stone around 1966.

The Chambersburg Formation, as exposed in the quarry (Berg and others, 1980), is characterized as a dark gray, flaggy-to-slabby bedded, carbonate mudstone (micrite) having a conchoidal-like fracture and generally containing minor amounts of fossil fragments of gastropods, brachiopods, bryozoans, crinoids (?), and corals, (?). Some of the fossil fragments are replaced by coarsely crystalline calcite and to a lessor degree, by pyrite. Some carbonaceous material is locally present along stylolites and calcite replacements. Up to one-inch-thick, black, slightly undulatory, argillaceous bands occur between the generally 4-10 inch thick limestone beds. Prominant, near-vertical joints are filled with both clay and calcite. These joints are used as temporary backs or quarry faces in the working benches. The median attitude of the beds is about N13°E, 20°SE while the median joint attitude is quite variable but trends N55°W, 70°SW. Prominant slickensides on some calcite-filled bedding surfaces (flexure slip) trend N16°W. The

**Figure 1. View of the active Caretti Quarry looking to the southeast. Note the flaggy to slabby bedding. Quarry waste is being backfilled to the west (right). Hydraulic rock cutter is in the foreground. Stockpile on floor of quarry is about 9 tons of random-size quarry-run.**

quarry face trends N30°E. Reserves remain on the east side of the quarry while quarry waste is backfilled to the west.

Quarrying is done mostly by hand. Initial benches are started by jackhammer drilling 1.5-inch-diameter holes about 4 feet deep on centers ranging between 2.5 feet and 4 feet parallel to the quarry face. Coarse-grained black-powder charges (typically, 10-to-20 ozs. in the bottom of the hole) are used as a blasting agent to reduce discordant fracturing and free workable blocks along bedding within benches. Conventional drilling and blasting has been unsuccessfully tried. Pry bars and muscle are standard working tools. The ring of a hammer against a sound rock, and a trained ear, constitute quality control.

Two basic types of stone are marketed; random-size quarry-run, which usually has one square corner, and random-size ashlar having eight square corners (Figure 2). Ashlar blocks up to 3 feet by 15 inches by 8 inches thick are cut by a hydraulic guillontine which reduces hand labor. Intricate keystones and other patterns can be

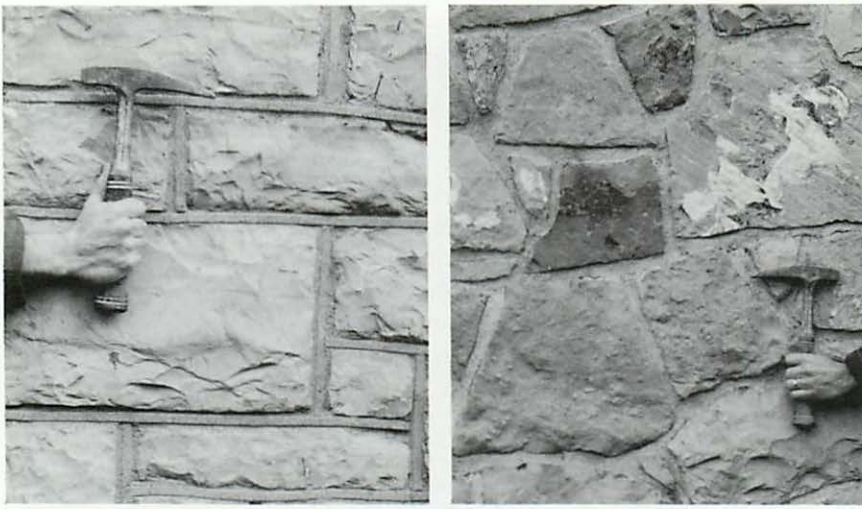


**Figure 2. Composite photo of basic types of stone produced. Left is ashlar with a "riser" below hammer handle. Right is random-size quarry-run showing "shiners" (dark blocks near top-center) and a calcite-rich bedding plane having slickensides (above hammer).**

cut on this machine, which exerts between 2500 and 3000 psi of force. The characteristic light gray color of the dressed stone is developed through weathering (intrinsically the stone is dark gray) or, for the less patient, by sandblasting. For visual contrast in walls, "risers" (blocks generally one foot or more in diameter), "shiners" (bedding-plane surfaces reflecting light from carbonaceous bands), and the slickensided calcite-rich bedding planes can be used.

The quarry annually produces between 200 and 700 tons of quality dimension stone for regional markets. In addition to being a source of building stone for Dickinson College and the Turnpike service area, this quarry has provided stone for Carlisle Hospital, Shaffer Medical Center in Lemoyne, and several private residences.

We thank Mr. Gregory R. Hess, President, and Paul W. Morrison, quarry foreman, Carretti Inc., for their help in preparing this article.

## REFERENCES

Berg, T. B. and others (1980), *Geologic map of Pennsylvania*, Pennsylvania Geological Survey, 4th ser., Map 1, scale 1:250,000, 3 sheets.

Rupp, I. D. (1846) *The history and topography of Dauphin, Cumberland, Franklin, Bedford, Adams, and Perry Counties*, Lancaster, Gilbert Hills.

# Diverse Fauna at Beaver County Fossil Locality

by John A. Harper

The Ames Limestone and associated shales have been recognized for many years as remarkably fossiliferous rocks in a relatively barren stratigraphic succession. The highest unit of the Glenshaw Formation, Conemaugh Group, the Ames is the most persistent and widespread Pennsylvanian-aged stratum in western Pennsylvania. The abundance of crinoid debris, especially columnals, makes the Ames easily recognizable and, in fact, gave the Ames its first name, the "crinoidal lime." Fossils are abundant in the Ames throughout western Pennsylvania and Maryland, eastern Ohio, and northern West Virginia, but as Raymond (1910) pointed out, "...it is only under favorable conditions that any variety of species can be obtained." Raymond listed 44 species of fossil vertebrates and invertebrates from the Ames at the Brilliant railroad cut in Pittsburgh, but such diversity is uncommon. More common are examples like the Ames at Beatty, Pennsylvania with only 5 species recognized by Raymond.

A newly examined Ames locality in Beaver County comes close to the Brilliant cut locality in faunal diversity and abundance, and with further collecting may prove to contain even more species than those reported here. Fully 31 species of invertebrates, vertebrates and trace fossils, and numerous unidentifiable fragments of brachiopods, molluscs, crinoids and vertebrate material, were collected and identified during two short visits to the locality. Among these are several species rarely or never before cited from the Ames of Pennsylvania.

The locality is in Beaver County, on the east side of the northbound lane of PA 60, the Beaver Valley Expressway, 0.3 miles south of the exit ramp to Aliquippa, and 0.7 miles south of Green Garden Road (Figure 1). The Ames crops out about 30 feet above the highway, but the best collecting comes from large slabs and blocks of limestone within a shale-chip and claystone talus slope formed by the underlying Pittsburgh "red beds" and overlying Birmingham Shale. The collecting locality consists of two sites approximately 100 yards apart, separated by a zone of sparse blocks. Site A, the southernmost, is a set of three large slabs of Ames lying on talus about 10 to 20 feet above the highway (Figure 2). The lowest slab is

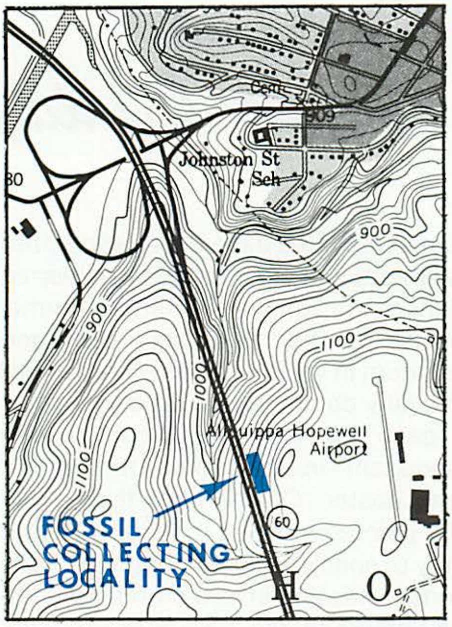



**Figure 1. Location of the Beaver County fossil collecting site along Pa. Route 60, the Beaver Valley Expressway at Aliquippa.**

also the largest and contains what appears to be the single most diverse fauna seen in the Ames. Smaller blocks of limestone also occur lower on the slope. Site B consists of small to medium-sized blocks containing a more "normal" Ames fauna (see Table 1). Both sites contain some interesting faunal elements, and three of these are discussed here.

1. *Enteletes hemiplicatus* (Hall), an orthid brachiopod, has been documented in the Ames of Ohio (Sturgeon and Hoare, 1968), but has not been recorded from anywhere else in the Appalachian Basin; it is more commonly found in the Pennsylvania rocks of the midcontinent area. At Site A, *Enteletes* is actually more common than some other brachiopods, particularly forms such as *Crurithyris planoconvexa* (Shumard) and *Wellerella osagensis* (Swallow) which is considered typical of the Ames in western Pennsylvania.

2. Identifiable platyceratid gastropods are extremely rare in the Conemaugh Group, even in the Ames with its abundant crinoid fauna (platyceratids are known to have lived attached to the anal openings of crinozoan echinoderms). Raymond (1910) reported two species in the Allegheny and Conemaugh Groups, but only one of these was cited from the Ames. Four well-preserved specimens of *Strophostylus girtyi* (Knight), a platyceratid, were collected from Site A. Most of the molluscs at this locality consist primarily of phosphatic molds and casts because of dissolution of their aragonitic shells. Those fossils which originally had calcitic shells, the brachiopods, corals and echinoderms, retain their shell structure and their character. This is also the case for the platyceratids, a gastropod group which had original calcitic shells.

Table 1. Faunal list from new Beaver County fossil collecting locality. Two sites, not actually separated, with Site A being the best collecting, Site B about 0.05 miles north of Site A.

| SPECIES | LOCALITY SITE A | SITE B |
|---|---|---|
| **Corals** | | |
| *Stereostylus sturgeoni* Bebout | X | X |
| **Brachiopods** | | |
| *Enteletes hemiplicatus* (Hall) | X | |
| *Derbyia crassa* (Meek & Hayden) | X | X |
| *Derbyia parvicostata* Sturgeon & Hoare | X | X |
| *Orthotetes conemaughensis* Sturgeon & Hoare | X | |
| *Neochonetes granulifer* (Owens) | X | X |
| *Hystriculina wabashensis* (Norwood & Pratten) | X | X |
| *Antiquatonia portlockiana* (Norwood & Pratten) | X | |
| *Reticulatia huecoensis* (King) | X | |
| *Juresania nebrascensis* (Owen) | X | X |
| *Linoproductus prattenianus* (Norwood & Pratten) | X | X |
| *Linoproductus platyumbonus* Dunbar & Condra | X | |
| *Wellerella osagensis* (Swallow) | X | X |
| *Hustedia mormoni* (Marcou) | | X |
| *Composita subtilita* (Hall) | X | X |
| *Composita ovata* Mather | X | X |
| *Composita elongata* Dunbar & Condra | | X |
| *Cleiothyridina orbicularis* (McChesney) | X | |
| *Neospirifer dunbari* King | X | X |
| *Crurithyris planoconvexa* (Shumard) | X | X |
| *Phricodothyris perplexa* (McChesney) | X | |
| **Bivalves** | | |
| *Septimyalina?* sp. | X | |
| *Wilkingia terminale* (Hall) | X | |
| **Gastropods** | | |
| *Knightites (Cymatospira) montfortianus* (Norwood & Pratten) | X | |
| *Strophostylus girtyi* (Knight) | X | |
| *Strobeus* sp. cf. *S. primogenius* (Conrad) | X | |
| **Cephalopods** | | |
| *Brachycycloceras curtum* (Meek & Worthen) | X | |
| *Pseudorthoceras knoxense* (McChesney) | X | |
| *Tainoceras collinsi* Sturgeon, Windle, Mapes & Hoare | X | |
| *Schistoceras hildrethi* (Morton) | X | |
| **Crinoids** | | |
| *Delocrinus* sp. | | X |
| **Fish** | | |
| *Petalodus ohioensis* Safford | X | |
| **Trace Fossils** | | |
| *Tremichnus cysticus* Brett | | X |
| **Miscellaneous** | | |
| Miscellaneous brachiopod spines | | X |
| Unidentifiable cephalopod fragments | X | |
| Miscellaneous columnals, plates & spines | X | X |
| Unidentifiable vertebrate debris | X | |

**Figure 2. Outcrop of the Ames Limestone (toward the top of the photo) along the northbound lanes of the Beaver Valley Expressway (Site A). Large slabs of Ames have broken away and are resting on shale-chip talus. The largest slab (center) has the most diverse fauna.**


**Figure 3. Surface of the Ames Limestone at Site A showing large amount of fossil debris, particularly crinoid columnals and brachiopods.**

3. As Brett (1985) has pointed out, a variety of previously unnamed trace fossils are found associated with fossil echinoderms, particularly crinoids. The name *Tremichnus* was coined by Brett for one type, expressed as circular or parabolic pits, often occurring in gall-like swellings, in crinoid plates. These pits are common in Middle Ordovician through Permian crinoid fossils, but in the North American Pennsylvanian such pits have only been described previously from the midcontinent area. Recognition of the ichnofossil *Tremichnus cysticus* Brett in crinoid stems from the Ames Limestone at the Beaver Valley Expressway locality positively extends the geographic range of Late Paleozoic *Tremichnus* into the Appalachian Basin.

Those interested in visiting this new fossil-collecting locality should be aware that PA 60 is a high-speed, four-lane, divided highway similar to an interstate highway. Because the collecting is restricted to the east side of the northbound lanes, there should be no reason to cross the highway. If you are approaching the locality from the north, you should go to the next interchange (PA 151) about 2 miles south where you can turn around and enter the northbound lane. Caution should be exercised in parking and walking on the road. Parking is available on the wide shoulders, and cars should be pulled as far off the side of the road as possible.

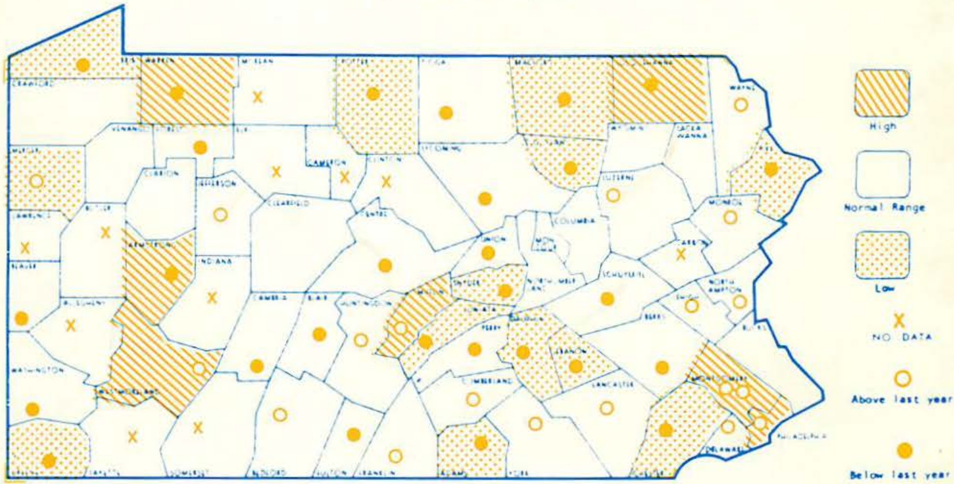
## REFERENCES CITED

Brett, C. E. (1985), Tremichnus: *a new ichnogenus of circular-parabolic pits in fossil echinoderms,* Journal of Paleontology, v. 59, p. 625-635.

Raymond, P. E. (1910), *A preliminary list of the fauna of the Allegheny and Conemaugh series in western Pennsylvania,* Carnegie Museum Annals, v. 7, p. 144-158.

Sturgeon, M. T., and Hoare, R. D. (1968), *Pennsylvanian brachiopods of Ohio,* Ohio Division of Geological Survey, Bulletin 63, 95 p.

# GROUNDWATER LEVELS FOR JANUARY 1986




Bureau of Topographic and Geologic Survey
Dept. of Environmental Resources
P.O. Box 2357
Harrisburg, Pa. 17120

Bulk Rate
U. S. Postage
PAID
Harrisburg, Pa.
Permit No. 601

*Address Corrections Requested*