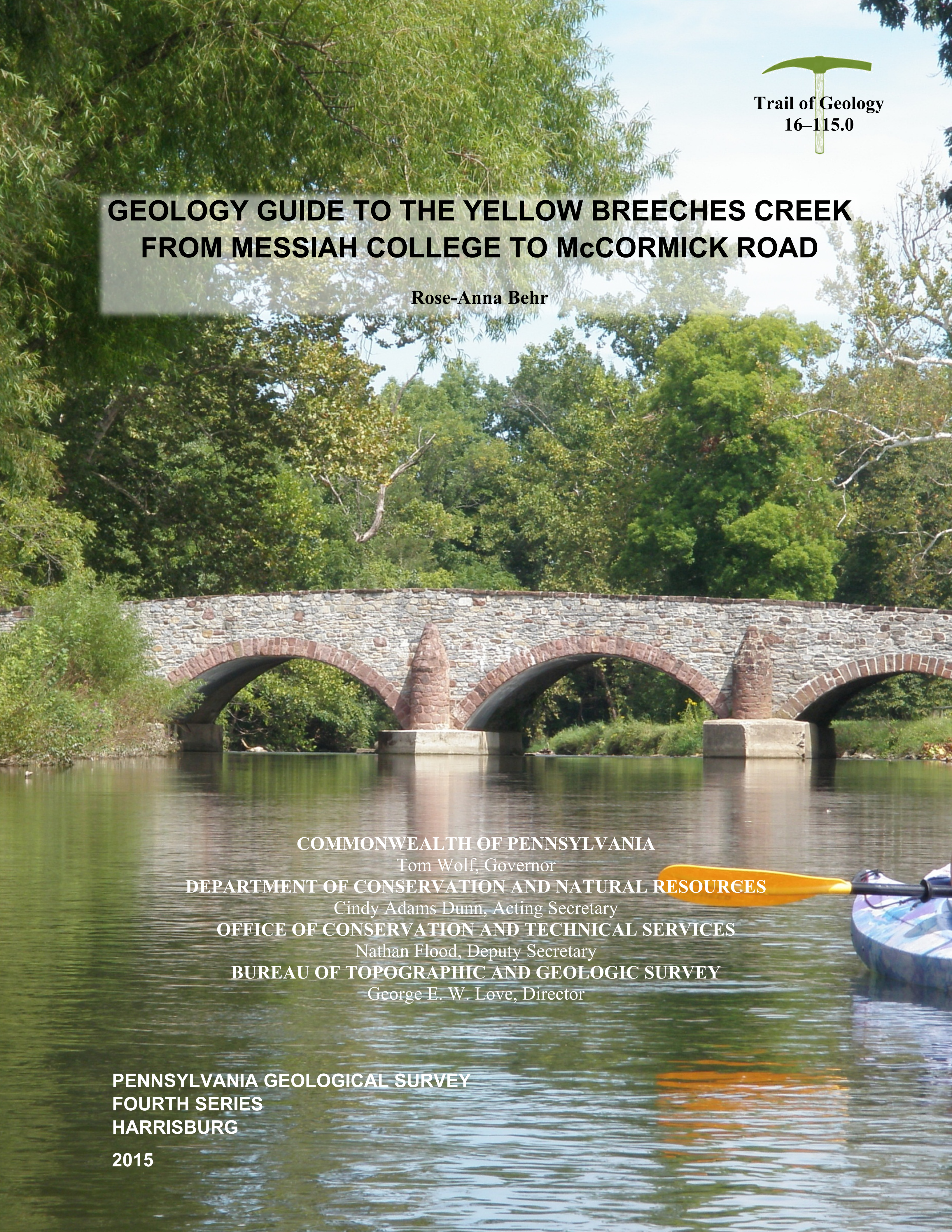

Trail of Geology
16–115.0

GEOLOGY GUIDE TO THE YELLOW BREECHES CREEK FROM MESSIAH COLLEGE TO McCORMICK ROAD

Rose-Anna Behr

COMMONWEALTH OF PENNSYLVANIA
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Cover Photo: View of Bryson & Conklin Bridge looking downstream. Photo by K. Hand.

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Table 1. Locations of stops mentioned in river log.

INTRODUCTION

This kayak trip explores the Yellow Breeches Creek from Messiah College to McCormick Road. It was originally prepared for the 2014 Field Conference of Pennsylvania Geologists preconference trip. This route is part of the Yellow Breeches Creek Water Trail, with established launch and take-out areas (Cumberland County Planning Department, 2012). Launch permits are required from either the Department of Conservation and Natural Resources or the Pennsylvania Fish and Boat Commission. The water level is kayakable at 1.2' but there will be some scraping. At a level of 3.0', some of the outcrops may not be visible. The water level of the creek can be determined at the USGS stream gaging station near Camp Hill (USGS, 2014).

The Yellow Breeches Creek originates on South Mountain in Michaux State Forest (Susquehanna River Basin Commission, 2007). The stream descends the mountains and meanders 49 miles through the Cumberland Valley to the Susquehanna River. The watershed is 219 square miles and includes Adams, Cumberland, and York Counties (Figure 1). The creek is a world-renowned limestone stream, a High-Quality Cold Water Fishery, and a designated Scenic River.

The creek name has changed over time (Rowland, 2001). It is unknown if the Susquehannock tribe had a name for the river, but the Shawnee tribe – who moved in after the Susquehannock's demise – knew the as Shawna Creek. For thirty years of their residency, the creek was also known as Callapus-Kinck, Callapus-Sink, Callapatschink, and Shawnee Creek. Callapatscink supposedly meant "where the water turns back again" (Miller, 1909). The creek name as we know it today was first recorded in 1734 as "Yellow Britches" Creek with reference to an old-timer who washed his britches in the creek and turned it yellow (Rowland, 2001). A second theory is that it is a corruption of Yellow Beeches, from the abundant beech trees that grew on the banks. By 1736, the name is mostly recorded as the Yellow Breeches Creek.

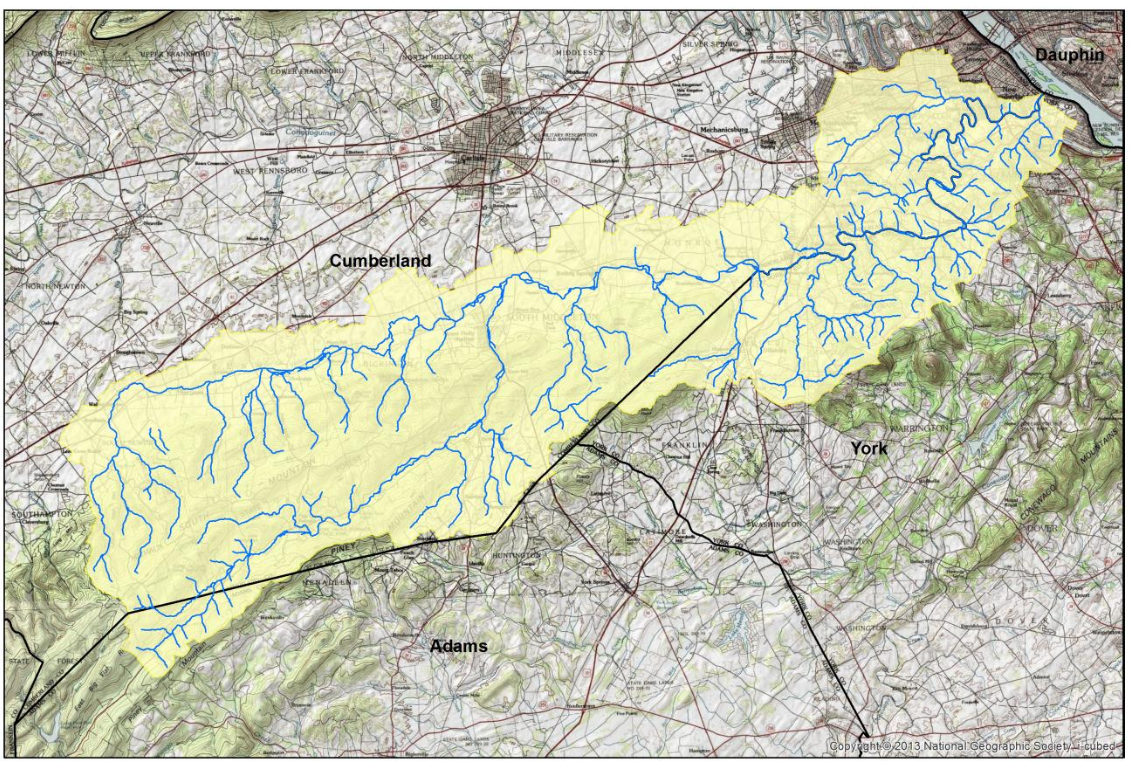


Figure 1. Yellow Breeches watershed covers parts of Adams, Cumberland, and York Counties.

SETTING

The Yellow Breeches Creek is famous for its trout fishing because it is largely a cold, limestone spring-fed stream. The stream meanders through two stratigraphic sequences of Cambro-Orodovician limestones and Ordovician shales before entering the Mesozoic rift basin and the setting for our trip. Downstream, it exits the Mesozoic basin and returns to the limestone and shale valley. Our trip will take us through Triassic sedimentary, intrusive, and metamorphosed rocks, and then out of the Triassic basin for one stop (Figure 2).

The Cambro-Orodovician limestones and Ordovician shales are grouped into two stratigraphic sequences: the Lebanon Valley sequence and the Cumberland Valley sequence. Though similar in age and lithology, the two have undergone disparate deformation events. The Lebanon Valley sequence was deformed into a series of nappes during the Ordovician Taconic orogeny. The Cumberland Valley sequence was folded into the gently plunging South Mountain anticlinorium during the Late Paleozoic Alleghanian orogeny that was part of the assembly of Pangea. Late Alleghanian deformation emplaced the Lebanon Valley sequence on top of the Cumberland Valley sequence on the aptly named Yellow Breeches Thrust. During our paddle, we briefly exit the Triassic basin and visit one exposure of Lebanon Valley sequence Ordovician-age Epler Formation.

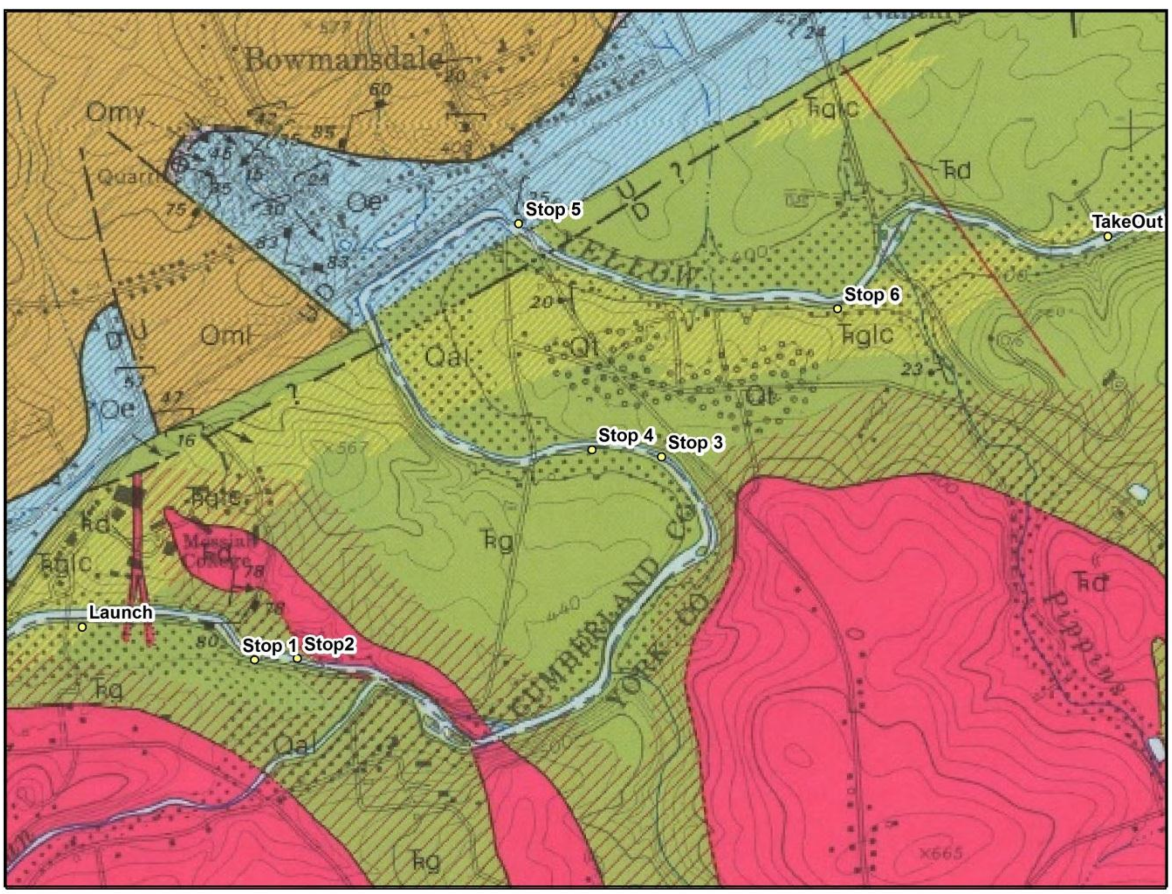


Figure 2. Geologic map of the river trip area (from Root, 1977).

SEDIMENTATION

Not long after Pangea was assembled, it began to tear apart. Several Triassic rift basins formed along the eastern seaboard as Africa began its departure (Glaeser, 1966). In Pennsylvania, Triassic rifting formed the Gettysburg and Newark Basins. The two are joined by a narrow neck. Our kayak trip will follow the north edge of the Gettysburg Basin. As rifting developed, steep-normal faults formed at or near the northern boundary of the basin. The basin was an arid closed, non-marine depositional setting. Periods of drying resulted in mud cracks, raindrop impressions and formation of glauberite, a sodium chloride phosphate that results from evaporation in arid lakes (Stose and Jonas, 1939). Sediments shed from a granitic source to the south slowly filled the basin 15,000 feet deep (Figure 3). The lower half of the basin fill, the New Oxford Formation, is dominantly sandstone with some conglomerates. We will not see them on this trip. As rifting continued, the sediment source shifted to the north. These sediments formed the Gettysburg Formation. The Gettysburg Formation consists of continental red shales and medium to fine-grained sandstones with a few conglomerates. Impure limestones interbedded with red shales have also been reported (Stose and Jonas, 1939). In the area we will be visiting, the sediments on-lapped the edge of the basin. The northern basin-bounding fault is buried somewhere south of the Triassic-Ordovician rock contact (Figure 4).

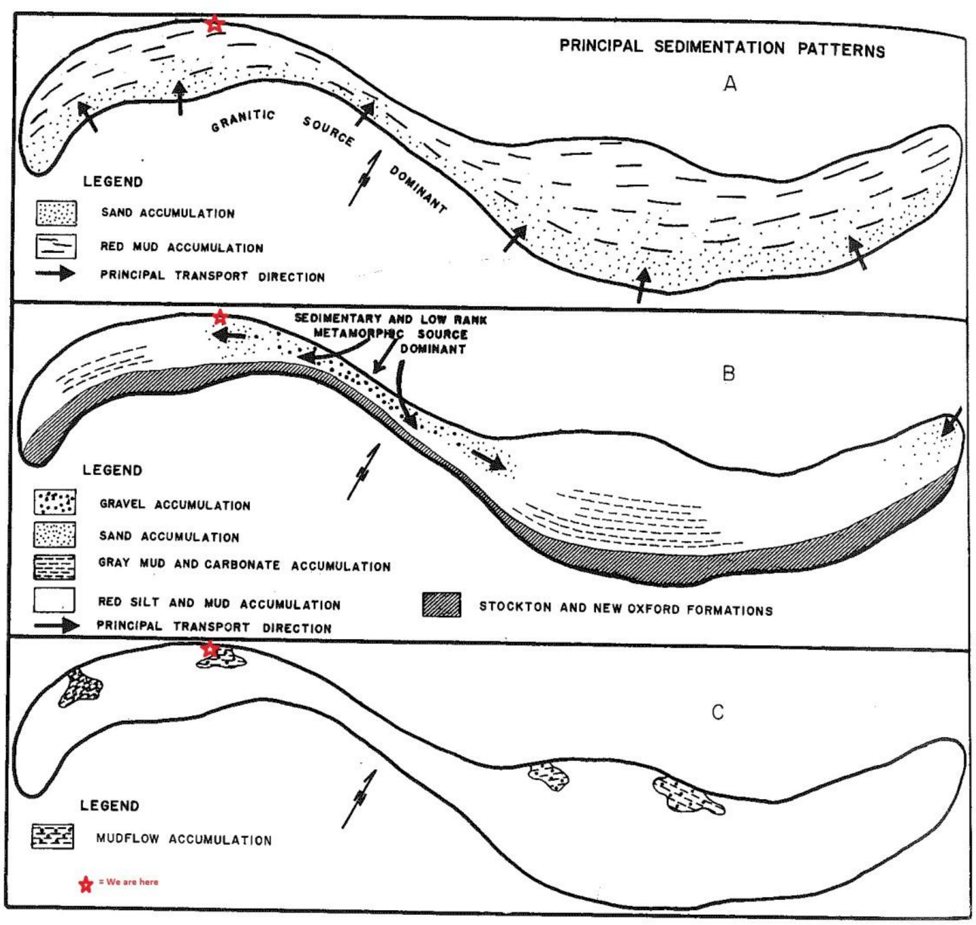


Figure 3. Basin-outline maps showing deposition of Triassic sediments. Wide area to the east (right) is the Newark Basin. Wide area to the west (left) is the Gettysburg Basin. Our area marked with red star (from Glaeser, 1966).

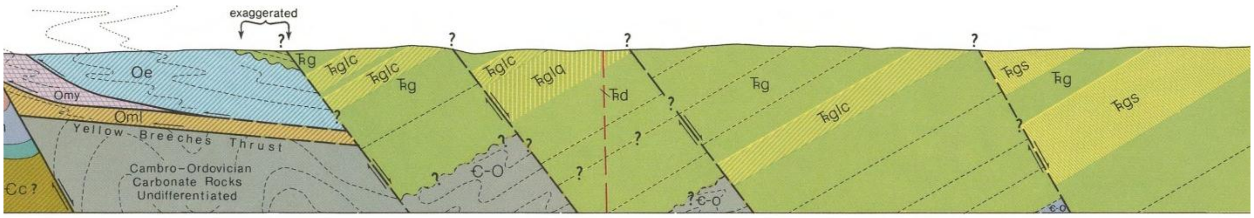


Figure 4. Cross section of Triassic basin showing dipping Triassic strata, normal faults, and sediments on lapping the edge of the basin (from Root, 1977).

The conglomerates are of interest and will be seen at more than one stop. They tend to be poorly sorted with a mud matrix. Clasts consist of limestone or quartzite, or limestone AND quartzite. Some clasts are fifteen inches across (Stose and Jonas, 1939). Angular limestone clasts are locally derived (Glaeser, 1966). Cobbles of Oriskany sandstone with large brachiopods have been reported, though it is a long way to any modern Oriskany outcrops. These conglomerates are interpreted to have been mudflows forming alluvial fans (fanglomerates) in the basin, similar to those in the southwestern United States today (Glaeser, 1966; Root, 1977). The conglomerates have been slabbed, polished, and sold as Potomac or Calico marble.

Several kinds of fossils have been reported in the Triassic in York County (Figure 5). Plant fossils include thirty-one species of ferns, equisetum, cycads, ginkgoes, conifers, and ferns. Dinosaur footprints have been recorded next door in Adams County (Figure 6). Crocodile teeth and crustaceans have been found in the New Oxford Formation. To the east, reptile and fish fossils have been found in the Gettysburg Formation. Keep your eyes open, it would be great to find them along the Yellow Breeches Creek.

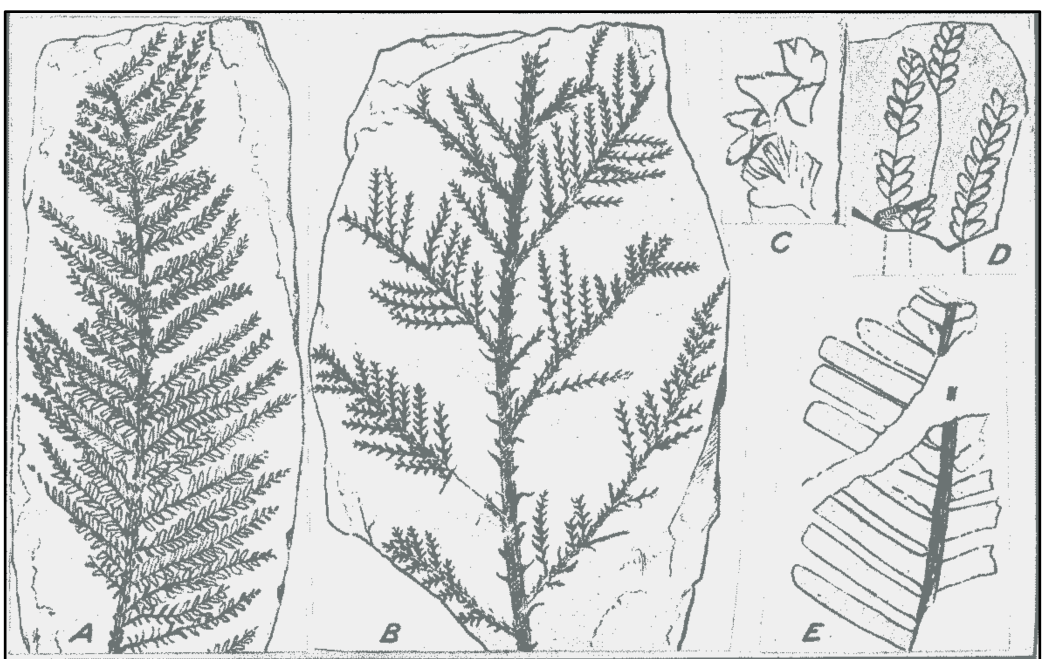


Figure 5. Plant fossils of the Gettysburg Formation collected and drawn by A. Wanner. A.) and B.) Conifer, C.) Ginkgo, D.) Fern, E.) Cycad. (Figure from Stose and Jonas, 1939).

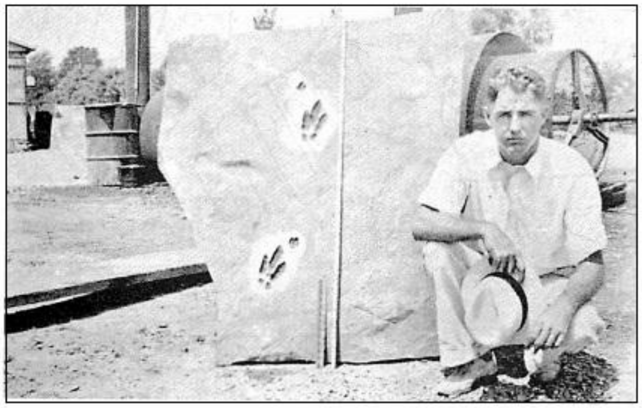


Figure 6. Footprints of *Anchisauripus sillimani*, a carnivorous dinosaur, in Gettysburg Formation sandstone from Adams County. (Figure from Stose and Jonas, 1939).

INTRUSION

As rifting continued, the continental crust grew thin, allowing hot magma to flow up the normal faults and bedding planes. The magma was quartz normative tholeiitic basalt, better known as diabase. It forms saucer-shaped sills and near-vertical dikes, taking advantage of joints and faults. The sills dip north-west, parallel to bedding. There are two types of diabase in York County, and ours is the York Haven type (Smith in Root, 1977). Titanium dioxide, which may be found in your sunscreen, forms 1.1% of the chilled margins. The mafic (dark-colored) minerals include olivine, augite, hypersthene, and pigeonite. The felsic (light-colored) minerals are mainly the plagioclase andesine. Labradorite, magnetite, apetite, and quartz are also reported (Stose and Jonas, 1939). The local term for the rock is ironstone. As you hammer on the outcrop at the diabase stop, you will understand why.

Several late-stage dikes were emplaced in the waning stages of the failed rifting. Stose and Jonas (1939) report one following a normal fault near the McCormick Road take out point. Root (1977) agreed with the dike placement, but did not agree it followed a fault.

METAMORPHISM

As the hot magma was emplaced, heat and hydrothermal fluids altered the surrounding rock. This process is called contact metamorphism. Typically, the red rocks are bleached gray. Rocks are baked hard to hornfels and porcelanite. The baked zone is typically a quarter-mile to a half-mile wide. Secondary minerals formed in the baked zone include epidote, specular hematite, zeolites, heulandite, and chlorite.

Four-tenths of a mile upstream from the launch point are the Grantham iron mines. High-grade magnetite ore was extracted from 1860 to 1890 (Stose and Jonas, 1939). The three mines are the Landis, or Fuller, Mine, which cut two tunnels from the railroad; the Porter Mine, which was forty feet deep and went fourteen feet below the creek; and the Shelley Mine, which cut through twenty feet of diabase to get to the ore. All extracted iron ore from the limestone fanglomerates near the diabase. Spencer (1907) reports no ore could be found in the dumps. More famous and extensive than the Grantham mines are the Dillsburg mines located about four miles south. The ores at both of these locations are referred to as Cornwall-type, but were not mined as extensively as those of Cornwall, Pennsylvania.

Associated with the iron ores and contact metamorphism are small yellow-green garnets. They are reported at the Grantham mines and a prospect pit on Stony Run (Stose and Jonas, 1939). Ten miles east of Grantham, a limestone fanglomerate whose clasts dissolved during metamorphism hosts beautiful, euhedral two centimeter-wide andradite garnets.

GEOMORPHOLOGY

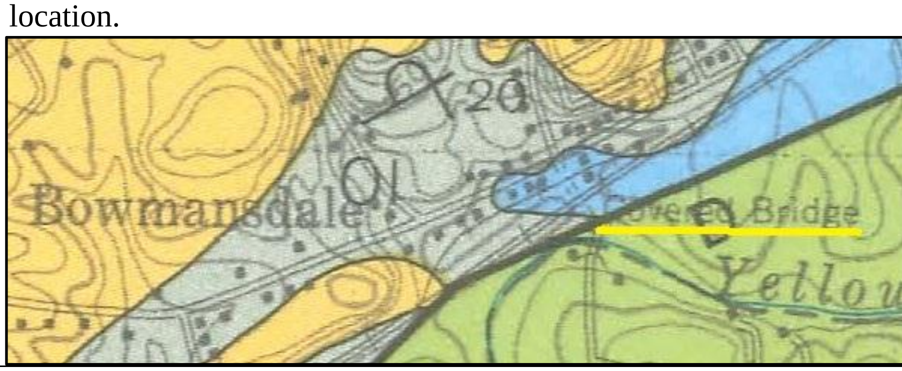
Stream terraces are benches above the creek, marking former water levels. Some terraces are well-developed surfaces; others are just marked by rounded rocks of the former streambed. Stose and Jonas (1939) mapped Eocene terrace deposits five hundred feet above the Susquehanna River. Root (1977) found these difficult to trace to the Yellow Breeches area. These high terraces are not planar, making them difficult to discern. Terrace deposits are generally several feet thick and locally up to ten feet thick (Root, 1977). Clasts are locally derived Triassic sandstone and conglomerates. Minor amounts of Paleozoic quartzitic sandstone with a red, sandy matrix are also noted. On the hilltop just east of Lisburn, Root (1977) mapped an extensive area of this terrace.

There is also a lower terrace of Quaternary age, forty to sixty feet above the creek (Stose and Jonas, 1939; Root, 1977). This deposit is a thin discontinuous veneer of well-rounded siltstone, sandstone, and quartzite clasts, with minor vein quartz pebbles in a poorly indurated reddish-brown silt-clay matrix. It is only a few feet thick along the Yellow Breeches (Root, 1977). Root has mapped this deposit west of Lisburn, and also south of our take out point along McCormick Road (Figure 2).

Alluvium is found along the modern stream. No effort has been made to map this carefully (Root, 1977). Along the creek bank, the author noted cobbles, gravel, and sand-size material of recent depositional age.

YELLOW BREECHES: MESSIAH TO MCCORMICK RIVER LOG

Figure 7. Bowmansdale Covered Bridge on the Messiah College campus just upstream of launch point. Photo by K. Hand.

Mile	Description
0.0	Put in on the right bank of the Yellow Breeches Creek just downstream of the covered bridge at Messiah College in Grantham, PA. The college maintains this public launch, and parking is permitted in the Starry Field Sports area lot. Stream elevation is 400 feet above sea level. Coordinates for stops can be found in Table 1.
	Bowmansdale Bridge (Figure 7) is a burr truss bridge built in 1867. It is a single span of 112 feet and is 15 feet wide. It was originally located in Bowmansdale (Figure 8) which we pass on our trip. In 1971, it was donated to the college and moved to its current location.  Figure 8. Covered bridge at Bowmansdale labeled in Stose and Jonas (1939) second printing.

0.14	Footbridge crosses creek.
0.30	**Stop 1 River Right**- As the river curves around to the left, a large cut bank with an outbuilding on top reveals a five-foot tall outcrop of Triassic rocks. About seventeen stratigraphic feet are exposed, as beds dip gently west. The rocks include slightly pink, coarse-grained sandstone with clay-rip up clasts, interbedded claystone and some blocky siltstone. A ten-foot thick bed of fanglomerate contains limestone, claystone, quartzite and chert clasts supporting each other in a clay matrix (Figure 9). This bed weathers easily into a lumpy, nodular, buff to pink, gray, and salmon-colored mess that at a glance looks alluvial. Limestone clasts in fanglomerates only occur on the north side of the Triassic basin, in very limited areas (Stose and Jonas, 1939).
	 Figure 9. Weathered fanglomerate with large clasts in a clay matrix. Clasts include limestone, claystone, quartzite and chert. Acid bottle for scale. Photo by R. Behr.
0.36	Sewage treatment plant outflow is on river left. Thirty feet downstream, there is a small poorly exposed outcrop of interbedded sandstone and claystone with well-rounded to subrounded alluvial quartzite cobbles capping it.
0.42	Cross into diabase around here.
0.48	Gravel bar on left contains diabase cobbles with visible crystals. A small spring issues forth just above the bar. The tributary is only 0.25 miles long but is mostly in diabase.
0.52	Stony Run enters river on right. Up this drainage were prospect pits for high-grade magnetite iron ore, where green andradite garnets were also found (Stose and Jonas, 1939). Some old maps call this Fisher Run.

0.55	**Stop 2 River Left**-Do not get out! As you approach the bridge on the left side, in the deepest, fastest moving water, you see a nice three-foot tall irregularly jointed outcrop of diabase. This is a three-hundred foot wide part of the Gettysburg sill. The sill caps the hills to the south, and largely the river has cut down through it. The diabase is fine to medium-grained depending on cooling rates. Colors range from dark gray to black. The rock has a salt and pepper appearance caused by white plagioclase (especially andesine or labradorite) crystals and black pyroxene (especially augite), magnetite, and rare olivine (Stose and Jonas, 1939). From here to the end of the riffles, we will be in diabase or skirting the very edge of it.
	Gilbert Road crosses on new bridge. This was the site of the historical pratt truss single-span bridge known as Gilbert Bridge or Halls Estate Bridge built in 1898 (Figure 10).  Figure 10. View of Gilbert Bridge with Stony Creek in foreground. Photo from Cultural Resources Geographic Information System, 2008.
0.61	This riffle was the site of the Thomas J. Stephens woolen mill, originally a clover mill. There are three channels of the creek below this. The southern passage is usually open and affords a nice view of a lovely little French house.
0.75	End of the diabase.
0.97	Intermittent tributary on right. Private Hunting Lease sign.
1.05	River Left, nice exposure of alluvium. Large cobbles of former streambed show well rounded quartzites, Triassic rocks, and possibly reworked cobbles from the Triassic deposits. The streambed is a staggered pavement of baked gray coarse-grained sandstone.
1.20	This riffle offers a bit of a challenge. Stay river right and shoot for the downstream pointed V of calm water. If you bump bottom, just keep your balance and scoot on through. I suspect there was a mill here, but cannot determine which from the records.
1.26	Just past the large riffle is a large hillside exposure on the right bank. Massive beds eight feet thick expose medium gray homogeneous baked sandstone. There are also some beds of dark brick-colored claystone baked to almost slate consistency.

1.44 **Stop 3 River Right-** Just past the ledge, drop on river right is a creekside outcrop with resistant conglomerate cap (Figure 11). Pebbles and cobbles are limestone, sandstone, quartz and angular claystone. Differential weathering of the cobbles and pebbles creates an artistic texture (Figure 12). A thin bed of claystone can be seen beneath the fanglomerate. It weathers more easily causing a recess. Bedding dips 14 degrees west-southwest.

Figure 11. Outcrop of Triassic conglomerate viewed from creeklevel. Photo by K. Hand.

Figure 12. Close-up view of differential weathering on the cobbles and pebbles in the conglomerate. Hand lens for scale. Photo by K. Hand.

<table>
<tr><td>1.55</td><td>Stop 4 River Right- As you enter the mill pool for the former Bishop Mill, the right side of the creek reveals a cliff of Triassic fanglomerate. The red color of the rock indicates it has not experienced metamorphism. Regular joints are spaced six to ten feet apart. One cobble is offset. Dissolution has occurred along one joint face (340/70), likely due to the calcareous nature of the matrix (Figure 13).

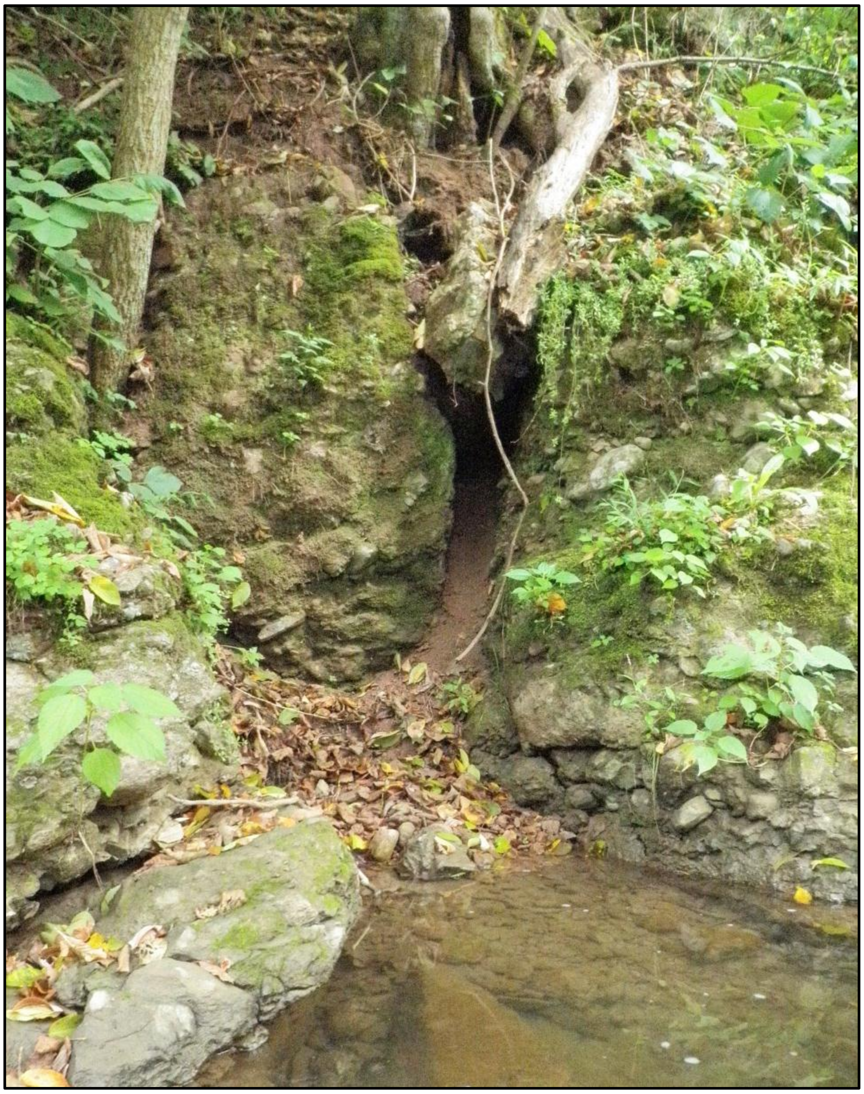



Figure 13. Dissolution along joint surfaces in calcareous fanglomerate in Bishops Mill pool. Photo by K. Hand.</td></tr>
<tr><td>1.63</td><td>Bishop Mill was located here. They milled many things, but only the carding machines are mentioned in Miller (1909). The milldam is breached and the center has a fun chute.</td></tr>
<tr><td>1.65</td><td>Bishop Road. Bishop Bridge was built in 1898, just two years before the Wrought Iron Bridge Company was bought out by the American Bridge Company (Figure 14). It is on the National Register of Historic Places (Historic Bridges, 2013). It was closed to traffic on June 30, 2014 (The Sentinel, 2014). Repairs will cost half a million dollars. Replacement would cost three million. Only two other bridges of this era remains on the Yellow Breeches. The Etters Bridge downstream near Green Lane Farms is also slated to close.</td></tr>
</table>

	 Figure 14. Bishop Bridge was built in 1898. Photo by K. Hand.
1.77	A nice little eddy forms in the river at the beginning of a long outcrop of hard red well-jointed claystone. Some of the joints anastomose. Downstream are more fanglomerate beds forming large cliffs. As you float along this riffle, enjoy the huge exposure of the youngest Triassic rocks of the basin. You are crossing the basin-bounding fault!
	Two mills and a distillery all operated between here and Bowmansdale.
2.05	Enter the Ordovician carbonates
2.08	River was straightened when the Philadelphia & Reading Railroad was built.
2.38	Old abutments from Bishop Road.
2.40	**Stop 5 River Left-** Just upstream of the bridge is a three-foot outcrop of limestone of the Epler Formation. This is our only stop outside the rift basin. Beds are finely laminated, medium gray to medium dark gray to medium bluish gray (Figure 15). They weather blue gray to dove gray with elephant skin texture. Joints are spaced every two to six inches. Dolomitized worm burrows, lenses of fossil fragments, dark gray to pink gray chert, and pink limestone are locally reported (Root, 1977). Typically, it is thought that the Triassic basin is bounded on the northern edge by a normal fault. This is true overall, but in the area we are in, the sediments actually on-lap the Ordovician carbonates (Figure 4). The normal fault, or more likely a series of normal faults, are further south. These Triassic sediments in the area near this bridge are the youngest in the entire basin!  Figure 15. Finely laminated limestone beds of the Ordovician Epler Formation indicate we have left the Triassic basin. Hammer head for scale. Photo by R. Behr.

2.42	North York Road bridge, and return to the Triassic. Simpson Park on left.
2.75	Tributary enters on right.
2.96	**Stop 6 River Right-** On the overgrown bank, you will see a low outcrop of brick red unbaked Triassic claystone with planar beds on top of brick red four- to six-inch thick sandstone beds. Red claystone beds are very weathered, forming chippy red clay-rich soil. A few stream-rounded cobbles are on top of the bank, indicating a former terrace.
3.07	Bryson & Conklin Bridge, named for two local families, was built in 1857. This four-arch bridge is on a private road (PHMC, Figure 16). Scout your route carefully. Usually the second to the right arch is best, but beware of submerged jersey barrier at the downstream opening. Avoid tree debris at all costs!  Figure 16. Photo of Bryson & Conklin Bridge looking downstream. Photo by Kristen Hand.
3.08	Pippins Run enters on the right and an unnamed tributary enters on the left.
3.16	Approximate location of an oil mill (Miller, 1909)
3.26	Extended outcrop on the left side of the creek reveals Triassic sediments, notably conglomerates. A thin diabase dike is mapped here somewhere. There are several dikes mapped in the county that post-date the main diabase emplacement. During the 1930's, gravel was quarried out of the creek near here for local concrete and road fill (Miller, 2004).
3.50	Exit river left onto McCormick Road, river elevation is 376 feet above sea level. Look up towards the barn and note the milk house on the left side of the driveway. During Hurricane Agnes, the Yellow Breeches flooded to this elevation, only ten feet above current river level (P. J. Wash, personal communication, 2013).

ACKNOWLDEGEMENTS

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