AMERICAN CANALS

BULLETIN OF
THE AMERICAN CANAL SOCIETY

BULLETIN NUMBER 45 | Editorial Address — Box 310 Shepherdstown, W. Va. 25443 | MAY 1983

PRESIDENT'S MESSAGE

By this time most of you are aware that our ACS Vice President, Dr. Bill Trout, has left California permanently and is now residing at his family home in Richmond, Virginia. One of our most ardent researchers, Bill has recently developed a computerized list of American Canals by States; a listing of American Canals arranged Alphabetically; a World Listing of Canal Postage Stamps; a listing of Canals on the National Register of Historic Places; an up-to-date listing of Canal Trips in the United States; and is working on a *Bibliography of* Historic Sites in Stream Beds.

In the past, Dr. Bill has also developed (and published) three excellent regional AMERICAN CANAL GUIDES, and is working on the fourth regional guide right now. He is also currently working on a complete History of the Canals of Virginia, which should soon be in print. It may be necessary for ACS to set up a special Sales Agent to handle all of the valuable "tools of the trade" which Bill Trout has developed. In the meantime, it is suggested that anyone having urgent need for any of the above studies might write Bill directly at 35 Towana Road, Richmond, Virginia 23336.

When not busy on research, Bill Trout is ably administering the affairs of the Virginia Canals and Navigations Society as President!

Since the last issue of AMERICAN CANALS, the following have joined ACS as LIFE MEMBERS: ***William A. Sigman***, *Indianapolis, Indiana*; **Desmond Harris**, Vancouver, B.C., Canada; and **Dr. Roger Squires**, England. This brings to a total of thirty-two those who have made a donation of $100 for a permanent place on our mailing list. (As of October 1, 1983, ACS LIFE Membership will be increased to

[illegible] regular issue of AMERICAN CANALS [illegible] May of 1983 is somewhat more brief than *usual because of the inclusion (as a special* eight-page insert) of Dennis McDaniel's excellent study on Indiana Canal Culverts, as published in a recent issue of THE INDIANA MAGAZINE OF HISTORY. McDaniel is the Director of Peale Museum in Baltimore and an ACS life member.

Bill Shank

LOWELL CANAL TOURS

Lowell (Mass.) National Historical Park's summer tour season featuring the popular Mill and Canal Tour began May 28, 1983. The Mill and Canal Tour, a three-hour journey by trolley, boat and on foot, highlights the history of Lowell's mills, canals, and people. The tour includes a mill exhibit, working gatehouses, and barge rides on the Northern and Pawtucket canals. Reservations are required for this free tour which will be offered nine times daily through October 10, 1983. For information and reservations call (617) 459-1000.

OLD LOCK GETS NEW LIFE

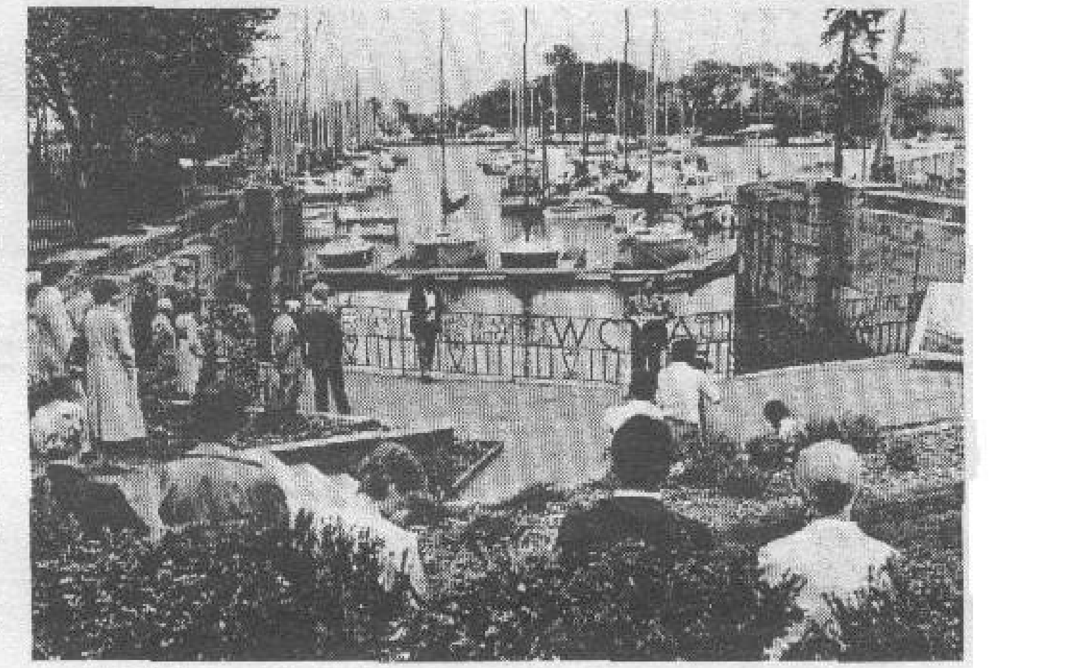


Photo by Mike Conley of the St. Catharines "Standard", showing ceremonies at the fine old lock on the Second Welland Canal at Port Dalhousie.

In June 1982, the Welland Canals Preservation Association held the official opening of rebuilt "Old Lock One" (of the Second Welland Canal), in Old Port Dalhousie, St. Catharines.

The following is an excerpt from the speech given at the opening by W.C.P.A. President, Richard R. Fair:

"One hundred and fifty-four years ago, on a chilly November day, there was another ceremony taking place in this very spot . . . The occasion was the official opening of the First Welland Canal. Crowds of excited onlookers lined either side of these banks to cheer as the first two schooners were sent on their historic voyage to Buffalo, New York . . .

"Lock One looked much different in 1829. It was smaller and made of oak timber, but it did the job during those important first years of the canal.

"Within a decade, the picture changed: Lock One, along with the other thirty-nine wooden locks of the original canal, was rapidly decaying and in need of replacement: steamships were beginning to replace the smaller sailing vessels; and costly canal maintenance had brought financial ruin to the Welland Canal Company.

"In 1837, the Province of Upper Canada took over the Canal and proceeded with plans to construct a second one roughly paralleling the original route. The locks were increased in size, rebuilt using local limestone, and reduced to twenty-seven in number.

"Lock One was given special attention when rebuilt. It was made 50 feet longer and 18½ feet wider than the standard lock, to allow steamers to enter the canal . . . By 1845, the small village of Port Dalhousie was fast becoming a bustling town centered around the busy canal. Shipyards and factories developed, and hotels flourished with the constant flow of sailors.

"Lock One remained in service until the completion of the Third Canal, in 1881 — after which it fell victim to abandonment, neglect, and progress. Three-quarters of its length was filled with rubble and dirt while Lakeport Road was built over its southern-most end.

"In 1981, in co-operation with the City of St. Catharines, and with the assistance of a Canada Community Development Project Grant and numerous private donations from members of our community, the Welland Canals Preservation Association began digging out the remains of these beautifully intact walls of Old Lock One . . . Today, as you can see, a long-time eyesore has been transformed into a place where residents and visitors can stroll, sit and reflect on the beauty, workmanship and historical significance of this spot, the 'beginning' of the Second (and First) Welland Canal."

Development of the remainder of the park on what was formerly known as Lockhart Point is well underway and is worth a visit.

(From Autumn 1982 Newsletter of the Welland Canals and Preservation Association.)

American Canals

BULLETIN OF THE AMERICAN CANAL SOCIETY

"DEDICATED TO HISTORIC CANAL RESEARCH, PRESERVATION AND PARKS"

AMERICAN CANALS is issued quarterly by the American Canal Society, Incorporated. Objectives of the Society are to encourage the preservation, restoration, interpretation and use of the historic navigational canals of the Americas; to save threatened canals; and to provide an exchange of canal information.

Annual subscription to "AMERICAN CANALS" is automatic with a minimum ACS dues payment of $10.00. Individual copies may be purchased at $2.00.

WILLIAM H. SHANK, P.E. — President; Publisher of "American Canals" — 809 Rathton Road, York, PA 17403

Capt. THOMAS F. HAHN, Ed. D. —Editor of "American Canals"; President Emeritus — Box 310, Shepherdstown, WV 25443

Dr. WILLIAM E. TROUT III — Vice President; Editor and Publisher of "American Canal Guides"; Chairman, Canal Parks Committees — 35 Towana Road, Richmond, VA 23226

CHARLES W. DERR — Secretary and Treasurer — 117 Main Street, Freemansburg, PA 18017

LOUIS J. CAHILL — Director for Canada — P.O. Box 745, 215 Ontario Street, St. Catharines, Ontario L2R 6Y3, Canada

Dr. ROGER W. SQUIRES — Director for the United Kingdom — Bailiff's Cottage, 4 Manor Way, Beckenham, Kent BR3 3LJ, England

TERRY K. WOODS — Director; Chairman, Canal Index Committee — 6939 Eastham Circle, Canton, OH 44708

WILLIAM J. McKELVEY, Jr. — Director; Chairman, Canal Boat Committee — 103 Dogwood Lane, Berkeley Heights, NJ 07922

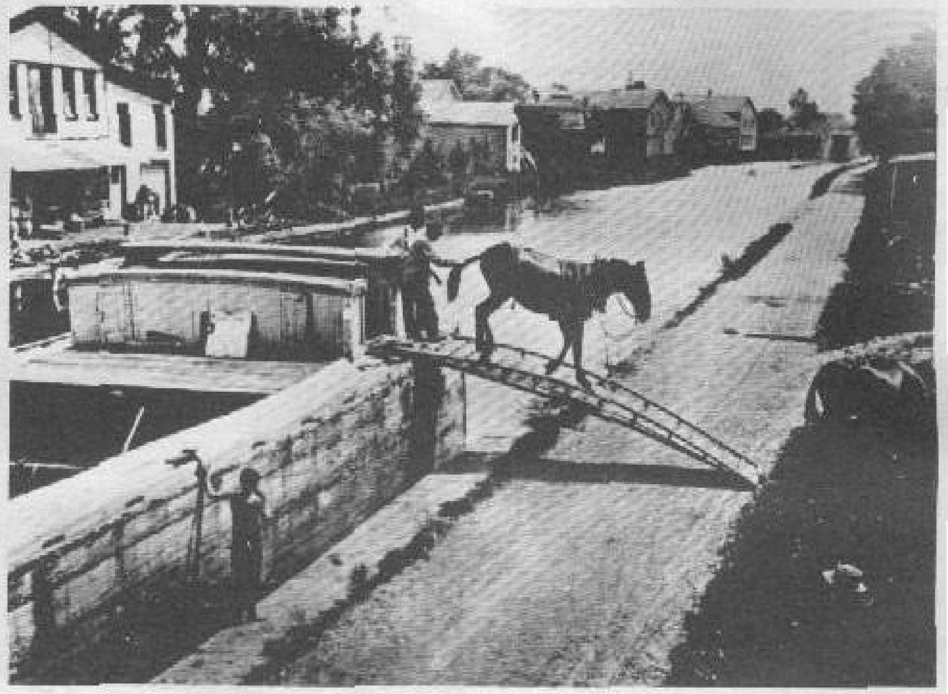
OHIO LOCKS PRESERVATION

The Great Miami River Corridor Committee, Miami/Shelby Counties, has formed a Lockington Locks Preservation Task Force to determine the possibility of preserving the majestic Lockington Locks at the summit of the Miami and Erie Canal.

The six locks and canal lockkeepers house are now on the National Register of Historic Places. Time has been kind to the structures but stones are starting to move from position and something needs to be done now to assure the locks existence for the future.

(See also Page 8)

HORSEBRIDGE ADDED AT MUSEUM



This familiar picture has been used many times in canal publications. It shows a canal boat crew "tailing off" a team of horses, over a horsebridge to shore. The photo was made, circa 1900, at Durhamville, New York, on the Erie Canal. (Courtesy Canal Museum, Syracuse, N.Y.)

A horsebridge has been installed between the west plaza and the Erie Laker bow at the Canal Museum in Syracuse, N.Y., giving visitors safe access to the Museum's major outdoor exhibit for the first time.

Historically, the horsebridge was carried onboard a Laker boat and was used in moving horses or mules from the forward cabin to the towpath. Carrying an extra team of animals allowed a Laker to travel the canal twenty-four hours a day, only stopping at six hour intervals to replace the working team, both mule driver and mules, with a fresh team.

The Museum's horsebridge, which consists of white pine and white oak with forged iron fittings, was constructed by J. M. Gray, Inc., of Syracuse. The working drawings for the horsebridge were developed by Dr. Robert Hager who served as canal boat historian on the Canal Boat Archaeological Needs Assessment and Location Survey project and was actively involved in the work to authentically reconstruct the Erie Laker bow.

The new horsebridge rounds out the exhibits in the west plaza which are designed to present visitors with a clear picture of the Weighlock Building's original purpose as a canal boat weighing station on the Erie Canal.

(From the "Canal Packet" for June 1983, official publication of the THE CANAL MUSEUM at Syracuse, N. Y.)

AMERICAN CANAL SOCIETY MEMBERSHIP BREAKDOWN

Several months ago, we made a geographical analysis of our 745 membership listing, to guide us in the selection of editorial material, and for the information of all of our members. Here is what we found:

Pennsylvania	138
New York State	89
New Jersey	59
Ohio	53
Virginia	51
Maryland	45
Illinois	33
Connecticut	30
Massachusetts	29
Canada	27
England	19
District of Columbia	19
Indiana	16
Florida	15
California	12
Michigan	12
West Virginia	9
Wisconsin	7
Vermont	6
Maine	6
Texas	6
New Hampshire	5
North Carolina	5
Delaware	5
Minnesota	4
Alabama	4
South Carolina	4
Tennessee	3
Missouri	3
Nebraska	3
Rhode Island	3
Kansas	2
Washington State	2
Oregon	2
Hawaii	2
Georgia	2
Holland	2
Alaska	1
New Mexico	1
Arizona	1
Oklahoma	1
Louisiana	1
Iowa	1
Kentucky	1
Mississippi	1
Sweden	1
Japan	1
India	1
Finland	1
Saudi Arabia	1

International? — You bet!

ILLINOIS AND MICHIGAN CANAL

This summer the Lockport Township Park District using a grant of $150,000 is designing a trail along the **Illinois and Michigan Canal** in Lockport. This trail will have interpretive signs so that those using it will understand the function of the canal in Lockport. Also, the Illinois and Michigan Canal National Heritage Corridor Bill is moving through the Senate and hearings on the bill in the House should be held this fall.

"MYSTERY PICTURE"

There were two responses to the "Mystery Picture" in the last issue. ACS Member Addison W. Auston speculates that it might be the Harpers Ferry Lock on the **Chesapeake and Ohio Canal.**

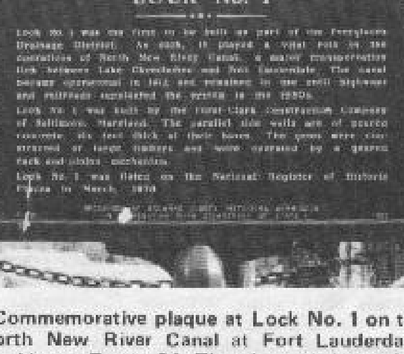
Todd S. Weseloh, Librarian/Archivist at the Canal Museum at Syracuse offers a further thought:

"First, I noticed that the artist's name is Abbey and I wonder if it might not be Edwin A. Abbey. There was an article about him and some examples of his work in **Bottoming Out**, Vol. III, No. 1 (October 1958) pp. 8-19. His signature is not quite the same in **Bottoming Out** as on your picture, but the style seems to be the same.

"On a wider bit of speculation perhaps your Mystery Picture is not of any specific canal at all. It could be what I call a generic canal picture which was meant to show generally what a canal was like. Such generic canal pictures were mainly used in geography texts in illustrating canals as transportation systems or as parts on man's alteration to the landscape. Your mystery picture is very similar to one in our collection and that is what brought this speculation to mind."

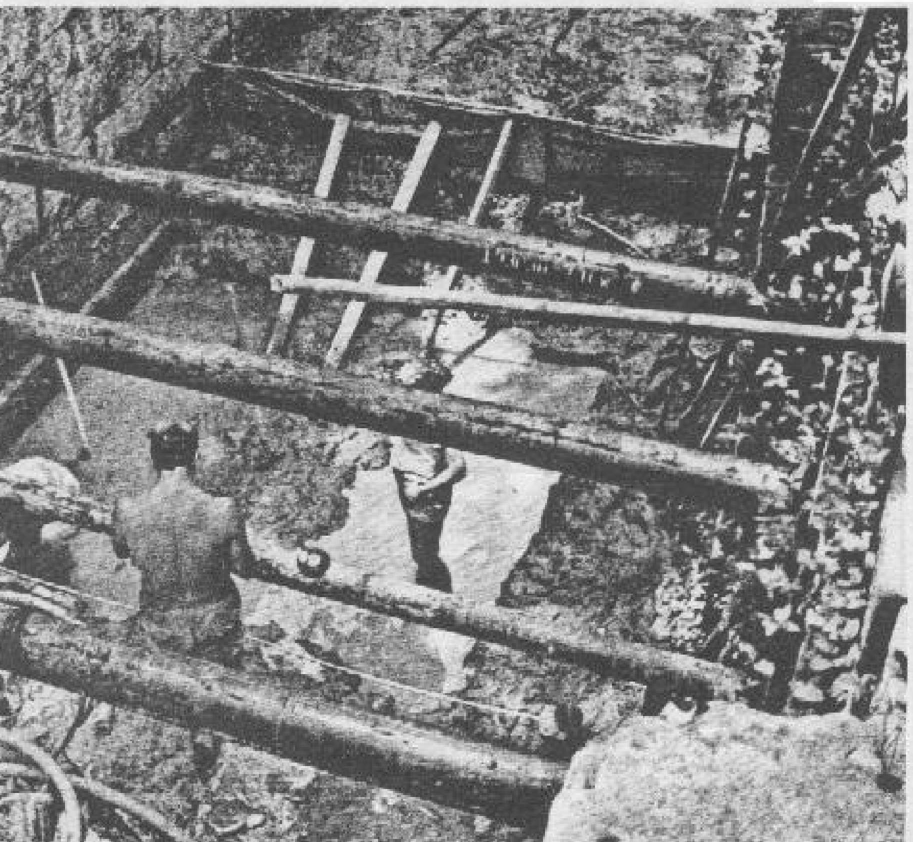
This is probably not the Harpers Ferry Lock 33 on the C & O Canal since that was a single lock, not a double. However, a double lock had been planned at one time and the scene is similar to that location. The "Mystery Picture" remains just that unless someone else comes up with something more specific. Perhaps Todd Weseloh is correct in stating that this may be a "generic" or composite picture of an American lock.

FLORIDA PLAQUE



Commemorative plaque at Lock No. 1 on the North New River Canal at Fort Lauderdale, Florida on Route 84. The plaque is located in the Broward Memorial Boat Lock Park. (Alden Gould photo)

GEORGE WASHINGTON'S CANAL



To the surprise of archeologists, the gates of lock # 1 of George Washington's Patowmack Canal were still intact under the soupy silt—the oldest surviving lock gates in North America. (Collection of the Department of Anthropology, University of Maryland.)

Water was important to the early residents of the capital city not only as a source of power, but also as a means of transportation. Across the Potomac River from the District of Columbia, at Great Falls Park, Virginia, are the archeological ruins of the Patowmack Canal and its associated town, Matildaville. This canal was George Washington's grand project designed to bypass the Great Falls of the Potomac along the river's southern bank in order to provide a commercial trade route to the west. Constructed between 1785 and 1802, the canal and its five locks provided a total lift of seventy-six feet in little more than one mile.

In 1979 stabilization work on the canal and locks required the removal of some silt from the bottom of lock #1. The soupy mixture had accumulated over the years since the canal went out of business in 1828. To the surprise of those involved, buried in the wet silt of the lower gate pocket were timbers and boards. Exploratory excavations the following year revealed that these artifacts are the remnants of the lock gates, left in a closed position upon abandonment of the canal. Subsequent research indicates that they are probably the oldest surviving lock gates in North America.

The lock gates were salvaged in 1982 as part of the two hundred and fiftieth anniversary celebration of George Washington's birth. The gates were uncovered by archeologists from the University of Maryland under contract to the National Park Service. After the gates were completely exposed, they were lifted out and taken to the visitor center at Great Falls Park, Virginia, where they are currently undergoing conservation treatment by National Park Service personnel. It will take two or three years to treat the waterlogged wood in order to prevent it from disintegrating or drying. During this time, the gates will be on display in a specially constructed room so the public can see this remnant of George Washington's engineering dream.

(NATIONAL PARKS - March/April 1983)

PORTAGE CANAL DOCUMENTS

Frederica Kleist has received from Earl Heydinger the **Report of the Transportation Route, Wisconsin and Fox Rivers in the State of Wisconsin between the Mississippi and Lake Michigan.** The report is dated 1876 from the 1st Session, Senate, Document No. 28. The Value of the document lies in its description of the rivers, the Portage Canal, and most importantly, the first Wisconsin River Lock. The report described the portage between the Fox and Wisconsin rivers as being 2500 yards. The report states that, "The portage runs over a marshy prairie. There is a Frenchman residing on the rising ground between the rivers. He keeps the proper transportation for boats and baggage."

Frederica Kleist requests that ACS members keep on the lookout for additional documents: An abstract marked "AA" which includes maps, 42nd Congress, Session, House of Representatives Document No. 185; maps showing the canals, locks, dams, and waterpower lots of the Fox and Wisconsin Improvement Company surveyed by W.S. Nearing, Assistant Engineer under the direction of Daniel C. Jenne, 1859; Appendix No. 26, 1901 Survey by Corps of Engineers Nos. 34, 35 and 36 and Appendix No. 27, No. 33; Captain Zinn's Report, Appendix, page 2, concerning the Portage Levee.

Readers knowing of the location of any of these papers are requested to write to Frederica Kleist, ACS, 328 W. Cook St., Portage WI 53910.)

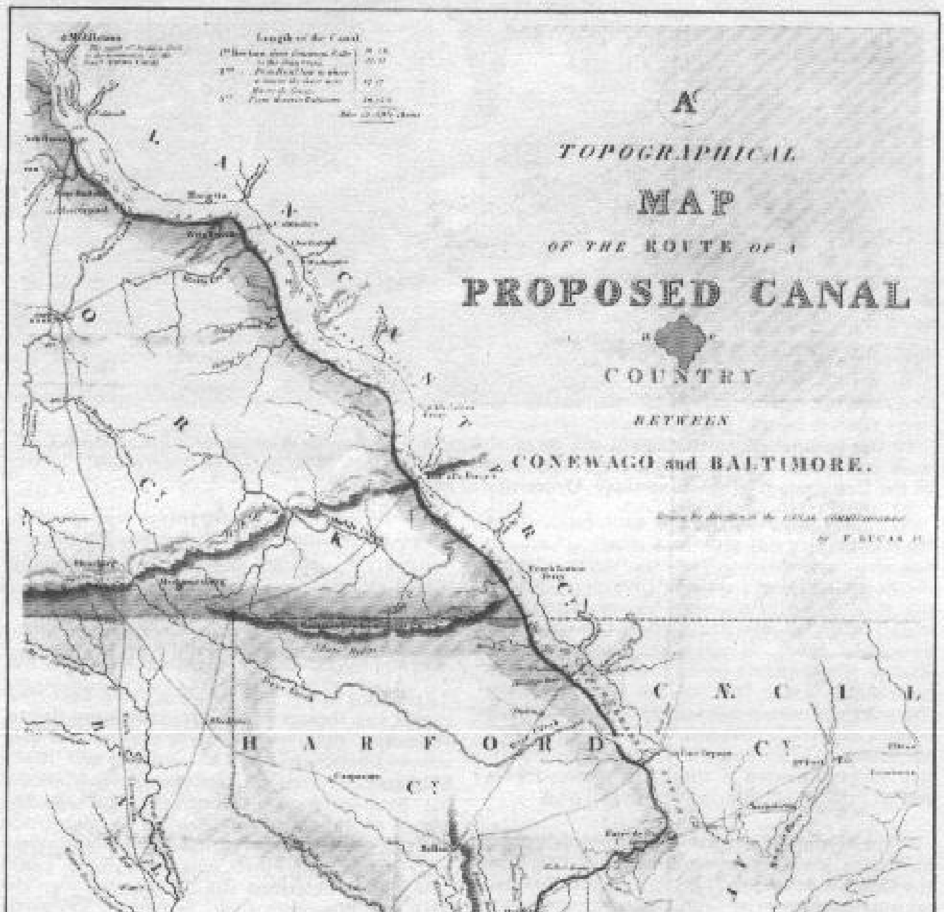
PROPOSED CANAL FROM BALTIMORE TO CONEWAGO

By George Thomas

As early as 1783, the importance of improving navigation on the lower Susquehanna was recognized in Baltimore with the signing of the charter for the Susquehanna (Port Deposit) Canal. The Baltimorians' intention was to increase their trade with this area at the expense of their rivals in Philadelphia. The canal was completed in 1802 but quickly proved to be inadequate and by 1817 it was bankrupt. Philadelphia's attempt at establishing a better trade relation with the Susquehanna had also been thwarted in 1805 when construction had stopped on the Chesapeake and Delaware Canal. By the beginning of the second decade of the 19th century, neither city had increased its trade potential significantly.

However, in 1822 renewed interest in two canal projects threatened to shift the balance in Philadelphia's favor. Contracts were being let on the Union Canal while simultaneously a prominent Philadelphian was reorganizing the Chesapeake and Delaware Canal Company. In response, the General Assembly of Maryland in December 1822 gave a mandate "directed to lay out, and survey a route for a Canal, which will connect the waters of the Susquehanna with the city of Baltimore, beginning at the Conewago falls, . . .".

The plan was to provide a canal with an inlet near the Union Canal so boats from the upper Susquehanna could just as easily pass south as to Philadelphia. Considering the inadequacies of the Union Canal, this was a good idea. Also, continuing the canal directly to Baltimore rather than stopping at tidewater would reduce the number of boats crossing the bay to the Chesapeake and Delaware Canal.



Map showing James Geddes' proposed route (1823) for a 93-mile canal connection between the City of Baltimore and York Haven, Pennsylvania. A 43-mile section of Geddes' route was used in 1839 by the Susquehanna and Tidewater Canal, running between Havre de Grace, Maryland and Wrightsville, Pennsylvania.

Setting out in June 1823, the appointed Maryland Canal Commissioners travelled to New York City and met with Mr. DeWitt Clinton, builder of the Erie Canal, who gave them advice (on the politics of canal building no doubt) and introductions to various engineers working on the Erie Canal. They proceeded to Albany and then along the Erie Canal until they reached the water filled section. By boat they proceeded 140 miles to Montezuma, crossed Cayuga Lake by steamboat to Ithaca, and travelled 29 miles overland to Owego on the Susquehanna. Here they obtained an open flat bottom boat and descended as far as Harrisburg, and finally by land back to Baltimore.

While on their trip through New York, they engaged Mr. James Geddes to be their canal director. He instructed them to have levels (surveys) made, so he could determine the best route. A local surveyor was hired for this task, but the terrain was too rugged to allow completion of the job by the time Mr. Geddes arrived. Therefore, the Commissioners petitioned the President of the United States, James Monroe, to supply two officers from the corps of topographical engineers. Expressing support for their project, the President supplied four officers who immediately began surveying from Conewago Falls to tidewater. These officers were the start of what is known today as the Army Corps of Engineers.

Upon completion of the river survey, Mr. Geddes arrived to take command. He determined that the best route was along the river from Conewago Falls to tide. A direct route overland to Baltimore was rejected because of the higher elevations that would have to be crossed, a deficiency of water in summer, and the "immense amount of mills and manufactories" that would have to be bought out if the streams were redirected to feed the canal. Likewise, the idea of bringing the canal down the east side of the river to McCalls Ferry, crossing on a aqueduct and continuing over the country to Baltimore was rejected. In the view of the Commissioners, the west side of the river was the only "manageable" choice for a canal route.

Once the river section of the canal was established, the surveyor for the City of Baltimore was contacted to complete the surveying from Havre de Grace to Baltimore. The Commissioners felt that stopping at tide would be unsuitable for the bay and transshipment would be required. They estimated that by canal a 40 ton boatload would cost $21 and take two days, while by the Chesapeake Bay it would cost $38-52 and take eight days. More importantly, they stated that Baltimore would not face competition from another seaport if the canal was completed all the way.

The canal would have been 92¾ miles long, divided into three sections in the following way:

Section	Length		Estimated Cost
1	41-5/6 (mi.)	(Conewago Falls to state line)	$1,220,265
2	14-1/8	(state line to tidewater)	564,471
3	37	(tidewater to Baltimore)	841,263

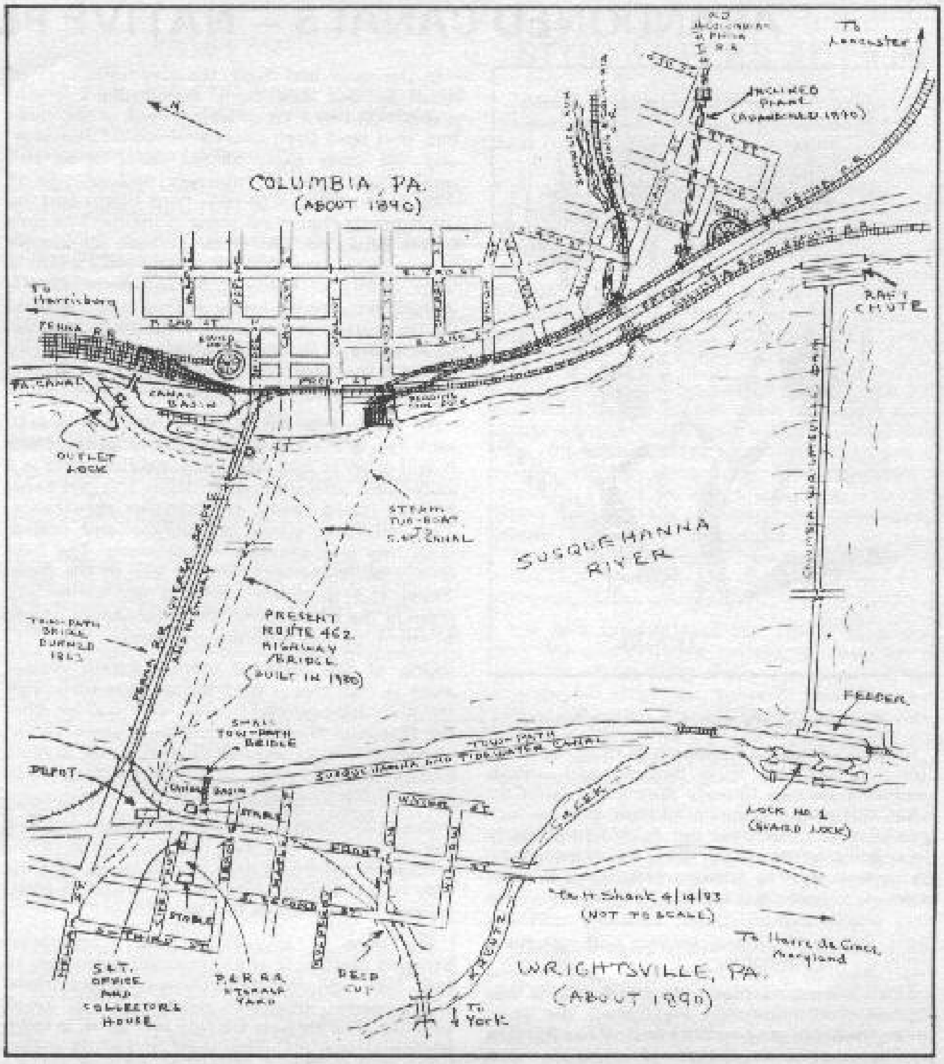
The Commissioners estimated the average toll through the canal as $1.50 per ton which on a volume of 200,000 tons would have given revenues of $300,000. This would have been more than enough to cover interest and expenses with some left over. Comparison of the distance and cost of transportation of goods shipped from Columbia to Philadelphia versus Columbia to Baltimore were $10 per ton over 74 miles of turnpike as opposed to $2 per ton over 80 miles of canal.

Additional projected benefits of the canal to Baltimore included an increased market for its products, such as fish. River navigation only allowed descending trade, consisting mostly of agricultural products, but with the advent of the canal, ascending traffic would have been possible too. Further justification of the canal included mentioning a 1793 report to the Governor of Pennsylvania on the feasibility of a water route to Pittsburgh. The Commissioners claimed that a route from Baltimore to Pittsburgh via the Juniata and Allegheny Rivers was entirely practical. They proposed two different alternatives, both of which required building a canal across the mountains which were ultimately scaled by the Allegheny Portage Railroad on the Pennsylvania Main Line Canal. This connection to the west would have stopped the Mississippi and Ohio River steamboats from taking trade rightfully belonging to Baltimore. Looking northward, the Commissioners asserted that a short canal could easily be opened between Seneca Lake and the Susquehanna, providing an all water route to Buffalo. Their route to Buffalo would only have been 30 miles longer than New York City to Buffalo over the Erie Canal.

The Commissioners concluded their report by begging the state to own the canal exclusively rather than allow a chartered or joint stock company have ownership and squander the money. The merits of J. Geddes were praised to the highest and lastly they justified the overrun of their travelling expenses while engaged in the canal survey.

The Maryland Commissioners never addressed the problem of how they expected to win approval for a canal which passed through Pennsylvania but gave all the spoils to Baltimore. Although the report was filed in 1823, it was not until 1835 that Pennsylvania finally authorized a Susquehanna canal. The big difference between the 1835 canal and the one proposed in 1823 was that the former ended at tidewater. This apparently gave equal chances to a boat proceeding either to Baltimore or Philadelphia. In 1839 the Susquehanna and Tidewater Canal was completed, essentially along the route mapped by Geddes in 1823, except that it stopped at Wrightsville rather than York Haven (Conewago Falls).

(The author, George Thomas, is an ACS member living in Toronto, Canada.)



Two years after James Gettys death, the Susquehanna and Tidewater Canal opened, along a portion of his 1823 survey route, to provide a junction between Chesapeake Bay and the Main Line Canal in Pennsylvania. The twin canal towns of Wrightsville and Columbia became the setting for some of the busiest inland waterway activities south of the Erie Canal, for the next fifty years.

CANAL CALENDAR

June 25, 1983 - Lehigh Canal Festival (with musical program) sponsored by Friends of the Hugh Moore Park at Easton, PA. For information write: Canal Museum, P.O. Box 877, Easton, PA 18042.

June 25-27, 1983 - Champlain Canal Cruise on "Emita II". (See details AC #43) Contact: Hayward Madden, 5847 Decker Road, Livonia, New York 14487.

June 27 - July 1, 1983 - Joint trip of Canal Society of New Jersey and Delaware and Hudson Canal Society along the path of the old Erie Canal. Contact: Paul Ross, 18 Circle Ave., Ellenville, New York 12428.

July 17, 1983 - Neversink Valley Area Museum Canal Day Picnic and Craft Sale, Cuddebackville, N.Y. For information on craft displays call Midge Riggs (914) 754-8747.

July 21-24, 1983 - Port Jervis (N.Y.) Heritage Commission celebrates Canal Days in Port Jervis, with an exhibit at the Farnum Building.

July 30-31, 1983 - Canal Days, Civic Holiday Weekend, Port Colborne. (Contact Heather Ott, Port Colburne Historical & Marine Museum, 280 King St., Port Colborne, Ont, L3K 4H1. Tel. (416) 834-7604.

September 22-25, 1983 - Heritage Canada Foundation Anniversary Conference in Toronto. Write: Albert V. Benoit, The Heritage Canada Foundation, P.O. Box 1358, Sta. B, Ottawa, Ont. K1P 5R4.

September 30-October 1, 1983 - Pennsylvania Canal Society Fall Tour along the D. & H. Canal. Headquarters: Holiday Inn, Port Jervis, N. Y. Contact: Grace Elliott, 300 N. Ohioville Rd., New Paltz, N. Y. 12561.

October 2-5, 1983 - Canal Society of Ohio Fall Tour along the Muskingum River on the stern-wheeler "Valley Gem", Marietta to Zanesville. Write Badstuber Tours, P.O. Box 32099, Euclid, Ohio 44132 or call (216) 289-6606.

October 7-10, 1983 - Steamship Historical Society Fall Meeting in Pittsburgh, PA, including a two-night cruise on the DELTA QUEEN, Pittsburgh to Wheeling, and return. Contact: your travel agent about the DELTA QUEEN trip SOON!

ILLINOIS CANAL ARCHIVES

The Illinois Canal Society has given an extensive collection of Illinois and Michigan Canal materials to Lewis University in Romeoville Illinois. The collection consists of maps of the canal and the area, early documents and letters, prints and photographs, oral history tapes and a number of secondary sources relating to the canals of Illinois and the communities along their course. The collection will form the basis of the Lewis University Canal Archives. The Canal Archives will be structured so that it can be used by students in local history courses at the University as well as the public at large. The Illinois Canal Society wants the collection to be as available to the public as possible. In order to achieve that goal the Illinois Canal Society has helped the university form an advisory council of 13 representatives from museums, historical societies, libraries, business and industry to form the Lewis University Canal Archives Advisory Council. This collection will be an invaluable asset in understanding the 19th Century development of Illinois, and the continuing waterway usage in the state. It will help develop an historical understanding of the area encompassed by the proposed Illinois and Michigan Canal National Heritage Corridor, of which it will be a part.

(John Lamb, ACS Director and President of the Illinois Canal Society)

ABANDONED CANALS – NATIVE PLANT HABITAT

Written and Illustrated by Juilia Meek

Indiana's canals are a source of much outdoor fun and activity. Ruin hunting and serious exploring are best in early Spring and late Fall, when foliage is at a bare minimum. But the lush growth that takes over the canal bed by early June is no reason to put away the cameras and picnic baskets. The Spring and Summer months produce a beautiful, wild mass of foliage that may impair exploring, but certainly makes a great setting for hikes, picnics and just plain enjoying the out-doors.

This striking display of native plants has pleased amd fascinated me for all the years we've been "canawling." At first, I was puzzled by the wide variety of plants, especially wild flowers, growing in such a condensed area. Then I began realizing that the actual composition of the canal bed produced several artificial growing situations that welcomed a diverse range of plants not normally found near each other. Speaking as a plant lover, (not a botanist), I would like to describe some of what you'll find growing there, and why, in hopes that you'll explore this lovely, wild treat for yourself.

When the canals were built (in the 1830's - 1850's) there was a thorough clearing of trees and scrub in the general area, followed by the digging of a shallow, wide ditch for the channel. The soil was irregular (often loose and porous) and the channel had to be faced with clay to prevent leaking. The banks, especially the tow-path, were built high and topped with gravel to insure stability and good drainage. From then until the mid 1870's the canal bed was maintained, and the surrounding area was mowed and kept cleared for canal traffic. When the canals fell into disuse, large portions of the right-of-way were bought up by power companies and rail road companies, or used for road beds. The cleared land and solidly built tow-path were a big head start for these particular building purposes. Much of the remaining land was sold as farm land, and the canal bed itself often provided, with little alteration, drainage for surrounding fields, These uses have kept long stretches of canal line undeveloped and free of large trees, and kept the soil conditions unchanged. Even the shallow ditch shape remains. The originally disturbed soil conditions probably quite rapidly attracted a variety of plants, mostly perennials spread by seeds, and the abrupt blend of soil features invited a unique combination of neighboring plants.

In the canal bed itself, the clay lining created moist to wet conditions, welcoming wet-land plants that like a lot of water. Parts of the canal bed that have been altered for better drainage, and the inner sides of the canal banks still retain quite a bit of moisture, and seem to be most favorable to high river-bank plants and the ditch plants that need some moisture. The tops of the banks and the wide towpath are usually very sunny, well-drained areas, and invite a large variety of hardy 'grow-anywhere' plants, including many we know as prairie and pasture plants, usually rather unceremoniously referred to as waste or wasteland plants, which actually thrive in the limestone gravel of the canal banks, and even grow well amid the stone ruins.

An early and distinctive perennial plant to look for is the **Horsetail or Shave Grass.** Since it will grow in any wet place and flourishes in a water-clay surrounding, it often fills the canal bed. It has a reedy, bamboo-like appearance. The tall, thin stems are hollow and ridged, with tiny grey sheathes at the joints. The fruit is in a cone-like spike on the end of the stem. These shoots appear early in the spring and quickly die off, soon to be replaced by a clump of stems, usually with naked points.

One of the showiest spring blooms in wet areas is the lovely **Wild Iris or Blue Flag.** This familiar, blue-purple flower (well named after the Rainbow Goddess, Iris), has fleshy creeping rootstock (rhizomes) rather than bulbs, as most cultivated varieties do. It spreads itself very well in favorable growing conditions.

Another crowder plant in the canal bottom is the tall, spiked **Cat Tail.** The perennial plants emerge in April and grow rapidly through May. One of the earliest exploration foilers, it often grows eight to fifteen feet tall.

The bane of anyone of foot is the **Great Stinging Nettle.** It is a dull green plant two to four feet high, with heart-shaped leaves armed with nearly invisible, very irritating, small prickles. The flowers are tiny and green in long, branched clusters. The sting of nettles makes this plant worth knowing in order to avoid. An on-the-spot remedy, if you have to learn this plant the hard way, is rubbing the nettle juice itself on the irritated area. The young shoots are harmless, and are, in fact, a tasty source of Vitamin C when prepared and eaten as a green. But from June until the first good frost – Look out!

Blue Vervain is a tall, elegant plant that blooms midsummer to Fall. This perennial plant has several stems with coarse, serrated leaves, and tiny purplish-blue flowers arranged in long erect spikes. It is hardy and will grow most anywhere on the bank-sides, but since it loves naturally moist soil, the largest and showiest blooms, often two to four feet high, will be found near the bottom of the canal bed.

Woody Nightshade is a shrubby plant that also thrives in moist banks and low, damp soils. The base of the plant is sturdy and covered with ashy-green bark. The long, slender branches straggle, and will grow many feet in length when supported by other plants. The small flowers are easy to recognize – small purple, star-shaped blossoms, with thin protruding yellow centers, arranged in loose, drooping clusters. Woody Nightshade blooms all Summer, and produces small berries which are deep red when ripe. (These berries are poisonous.)

Bouncing Bet, or Soapwort, is a perennial that tolerates all soils, and prefers sunny, dry, well-drained slopes. The erect stems, eight to twelve inches high, have long oval leaves and clusters of pink flowers that are five-petaled and roughly star-shaped. The long lasting flowers bloom all Summer. The plant contains soap-like substances, and the name Bouncing Bet is an old-fashioned name for a washer-woman.

An interesting canal plant is the **Great Mullein.** It is biennial, the first year's growth being a rosette of large leaves, six to ten inches long, two to three inches across, covered on both sides with a dense, furry mass of hairs. (this gives the leaves a very soft, velvety feel, and subsequently one of its most amusing nick-names: Indian Toiletpaper). The following Spring, a solitary, thick stem emerges. The stem, which grows three to five feet high, bears a thick, densely crowded flower spike usually a foot long. It is covered with yellow, cup-like blossoms which open irregularly through the Summer.

One of the most prolific canal perennials is **Catnip.** It grows well anywhere, thrives in well-drained soil, and spreads rapidly. Its erect branched stems are covered with downy, heart-shaped, serrated leaves. The leaves have green tops and white bottoms, giving the plant a dusty, grey-green appearance. The flowers appear from June through September. They grow in short spikes of tiny blossoms that are creamy white, dotted with purple. Being of the mint family, the leaves emit a pleasant, minty odor when bruised. Warning: Cats definitely recognize this odor, so cat owners are advised to snip a sprig or two to distract their pet, to preserve clothes and their skin!

Wild Raspberries or Blackberries also like a moist but well-drained soil, and are, (lucky us!) a very hardy canal perennial. This shrubby plant has serrated, heart-shaped leaves and is covered with stickers. It flowers in May and June, and produces luscious, deep purple berries in July. Blackberries love sunlight, do especially well in clay loam, and quickly take over large areas of canal bank.

A beautiful curiosity plant is the **Teasel.** This Biennial has a tall, rigid prickly stem, large pairs of leaves at the base, and a cylindrical flower head. They are, unfortunately, perhaps best known as an accent in dried flower arrangements. It is unfortunate because the bloom is lovely and the flower growth is very interesting. The flower heads are a mass of semi-stiff spines. Each head is enclosed by narrow green bracts arising in a ring at the base of the head and following its line. When the head flowers, the tiny purple florets show in a ring about half way down the head, and then spread in rings, which move upwards and downwards simultaneously.

A very popular plant is the **Prairie Cone-Flower.** It is a native of the western prairies that has spread rapidly through the midwest. It is a perennial that likes sun, is drought resistant and tolerates poor soil, so we find it growing crazily on the banks and tow-path. This daisy-like flower has a brown, cone-shaped center which is surrounded by yellow-golden petals arranged in rays. It has coarse, dark green leaves, grows two to four feet high and blooms all Summer.

We find several kinds of **Thistles** along the canal, since they thrive on dry banks, gravelly soils, and limestone. The tall branched stems, two to five feet high, and the coarse, dark green leaves are spiny, and the flowers are a brush-like crimson bloom. They have a delicate, sweet fragrance, and bloom through July and August.

The most fragrant plant, I think, is the **Chamomile.** It grows tufts of leaves and flowers up to a foot high. The stems are freely branching, covered with thread-like leaves that give the whole plant a delicate, feathery appearance. The small flowers grow solitary on long stems. They have yellow centers and a fringe of white petals. It is noted for its sweet scent of apples. (Chamomile, in Greek, means Ground Apples) When hiking, especially on a warm sunny day, the scent is a real treat. Chamomile is a perennial that loves dry, gravelly soil, and spreads rapidly over the bank tops.

Toadflax or Wild Snap-Dragons prefer dry soil too, especially limestone, and spread quite rapidly. The plant has several slender stems, not too branched, one to two feet high. The stems are covered with many long, narrow pale blue-green leaves. The stems hold spikes of showy yellow blooms. The pale yellow flowers are shaped like snap dragons, but with long spurs, and the lower lip of the blossom is orange. This gives it its popular nickname: Butter and Eggs. This perennial blooms late June to October.

This is but a small sampling of plants to look for and enjoy. **Dog Roses, Yarrow,** many members of the **Sunflower or Daisy** family, **Oyster Plant, Wild Grapes,** and many native grasses crowd the canal, and the list goes on and on. From the first warm days of Spring until the heavy frosts, the canal lines are alive with beautiful, interesting greenery. The mixture of plant-life is fantastic, and the wild flowers, Spring through Fall, are a special treat.

BIBLIOGRAPHY:

AUDUBON SOCIETY FIELD GUIDE TO NORTH AMERICAN WILDFLOWERS – EASTERN REGION
Chanticleer Press 1979

A MODERN HERBAL by Mrs. M. Grieve
Dover Pulbications 1971

CONCISE ENCYCLOPEDIA OF FAVORITE WILD FLOWERS by M. Dietz
Doubleday & Co. 1965

ENCYLCLOPEDIA OF ORGANIC GARDENING
Rodale Books 1975

THE HERBALIST by Joseph Meyer 1972

WILDFLOWERS by H. L. Pursey
Hamlyn Pub. Group 1978

VALUING YOUR WETLANDS by Carolyn McNagney
ACRES, Inc. 1982

***Julia Meek** and her husband, Thomas Meek, were the guiding lights behind the founding of the Indiana Canal Society several years ago. Tom and Julia are now Co-Editors of INDIANA WATERWAYS, the Bulletin of the new society. The fore-going article was published in INDIANA WATERWAYS, August 1982.*

STEAMSHIP REPLICA ON THE ST. LAWRENCE

The "Canadian Empress" is now available for 2-night, 3-night and 6-night tours of the St. Lawrence between Kingston, Ontario and Quebec, P.Q. The "Empress" is a 32-stateroom replica steamship operating on a regular schedule May through October, with rates starting at $270 (Canadian). The full trip includes passage through all the locks of the St. Lawrence Seaway! Contact: Rideau - St. Lawrence Cruise Ships, 253 Ontario Street, Kingston, Ontario, Canada K7L 2Z4, or phone 1-613-549-8091 for reservation information, (and a colorful brochure).

STUDY SEEKS ACTION

Moving to reinject momentum into the effort to gain increased funding to improve and maintain the nation's 25,000-mile inland waterway system, the Corps of Engineers has released the draft of a national waterways study that estimates investment requirements at between $5.2 billion and $12 billion in the next two decades. At the same time, the assistant secretary of the Army for civil works, William R. Gianelli, is circulating the draft of a user-fee bill designed to recover 70% of expected operation and maintenance costs incurred by the Corps and the Tennessee Valley Authority.

"This legislation represents a move in a new direction to try to get some discussion going about what might be workable, "Giannelli says. the 70% cost-recovery target for both system-wide and segment-specific fees represents a departure from an effort last year when the Army sought 100% recovery from user fees for inland waterways and coast port dredging. "There was too much stonewalling and not much movement on the inland waterway issue last year," Giannelli says.

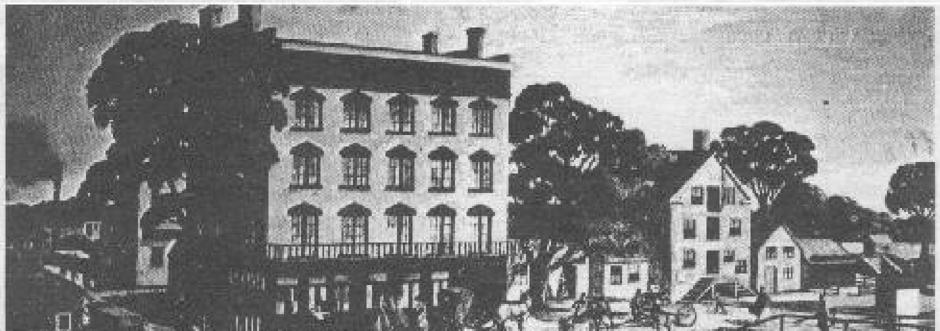
His bill, currently at the Office of Budget and Management for review, is designed to generate about $225 million in fiscal 1984 – enough to cover the administration's budget targets. So far, the bill does not have any congressional sponsors, and Gianelli indicates he will seek industry input before pushing for administration backing.

One other novel feature of the legislation is that it authorizes the Secretary of the Army, in consultation with the secretaries of Agriculture and Transportation, to levy "congestion fees" on users of specific facilities to reduce delays.

The waterways study estimates that multi-billion-dollar investment needs between now and 2003 would be required to cope with an expected cargo traffic growth of between 24 and 51%. The four leading growth commodities are coal, agricultural products, metals and ores and chemicals and fertilizers.

(The above article was sent to us by Robert Mayo, ACS Director, as clipped from the April 7, 1983 Issue of ENGINEERING NEWS RECORD.)

ALONG THE ERIE CANAL

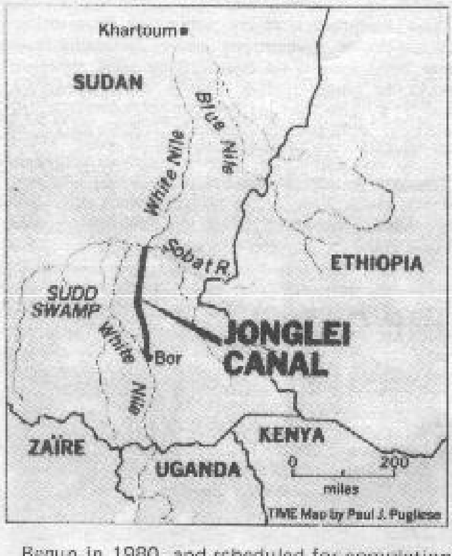


This artist's drawing shows the old Mansion House (Circa 1824) on the Erie Canal at Rome, New York, near its junction with the Black River Canal. The Mansion House was a favorite "stop over" for canallers. (Sent us by ACS Member Jim Wilson.)

CANAL SHOW BY ACS PRESIDENT

ACS President Bill Shank was recently invited to display his sizable collection of canal artifacts, historical photos and other canal memorabilia in a month-long exhibition, Special Collections Room, York College of Pennsylvania. Bill is shown here during the opening reception, attended by some fifty historians from the York area. (Photo by Tanya Wood.)

THE JONGLEI CANAL



Begun in 1980, and scheduled for completion in 1985, the excavation of the Jonglei Canal in southern Sudan (as shown on the map) will be one of the world's largest artificial waterways at its completed length of 220 miles.

The canal is named after the Jonglei Province that it crosses. Its purpose is to divert 30 percent of the flow of the **White Nile River,** estimated at 5.2 billion gallons of water per day, around the Sudd Swamp, to the lower portion of the White Nile River.

Envisioned by the British in the early 1900's, the current project is being built by the French Compagnie de Construction International. The channel of the canal will be 15 feet deep and 170 feet wide. A key to the success of the Jonglei Canal is SARAH, a West German-built eight-story high excavator named after a Sundanese official's daughter. SARAH was previously used in the construction of a canal between the Indus and Jhelum rivers in Pakistan. *(Adapted from TIME, 10 Jan. 1983.)*

FIGHTER TAKES THE PLUNGE

At a Carmen Basilio Fight Night recently at a bar in Hagerstown, Maryland, your Editor had occasion to talk with the ex-welter weight and middle weight world champion. When Mr. Basilio told me that he was from Sarasota, New York, I remarked that he might be familiar with the **Erie Canal.** He said that he spent many a day on the canal, and that he had fallen through the ice more than once while ice skating in the winters there. Boxing enthusiasts may be interested in knowing that Mr. Basilio is still in good condition and is a very amiable and interesting person to talk with.

GREAT MIAMI RIVER CORRIDOR

(The following items are from the Great Miami River Corridor Committee Annual Project Report of 1982.)

Boone Lock: One of the best-preserved canal locks between Cincinnati and Defiance is located just south of Troy off Boone Drive. Privately owned, the Miami County Coordinator has met with the property owner to advise him of the historic significance of this structure in hopes he will preserve this impressive remnant of the **Miami & Erie Canal.**

Turtle Creek Culvert: In mid-July, a local contractor began the thankless task of demolishing this majestic 140-year-old structure. Many concerned individuals and agencies had worked for over four years to find a way and the means of saving this deteriorating monument to the pioneer spirit of the canal era. The Great Miami River Corridor Project sent a final, impassioned plea for financial assistance to many of the largest national foundations. But the emotional plea for assistance fell on sympathetic but unresponsive ears. The demolition of the Turtle Creek culvert leaves a new void on the National Register of Historic Places.

Lockington Project -

Locks: Workers from the Shelby County Work Relief Program swarmed onto the locks in early September to rid the grand structures of an unsightly accumulation of weeds, brush, and debris. It is hoped that this cleanup will also be an annual Corridor project.

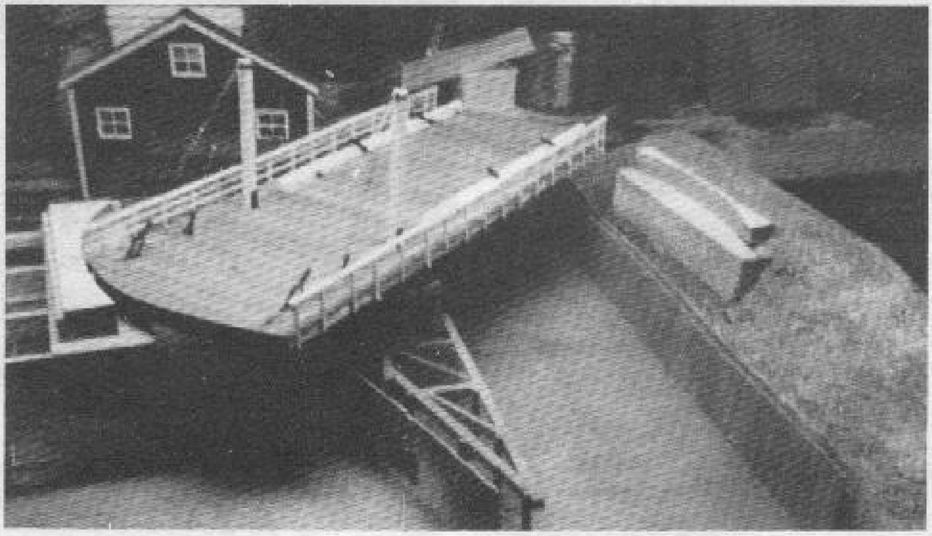
Canal Rush: At the request of the Heritage Festival Committee, the River Corridor sponsored a "Canal Rush" during the Labor Day festivities. The nearly sixty canoeists and numerous spectators who lined the rewatered section of the Miami & Erie Canal at the Johnston Farm complex enjoyed the excitement and humorous antics of this very successful two-day event.

Hiking Trail: The Buckeye Trail parallels the Great Miami from Dayton to the Piqua Historical Area, where it picks up sections of the Miami and Erie Canal through Shelby County.

Farrington Lock: Members of the Piqua Task Force began clearing and cleaning the Farrington lock on June 13th. Located south of Piqua, this site has been used as a dump for years.

(Provided by Terry E. Wright, ACS, Miami County Corridor. His address is 1511 Garfield St., Piqua, OH 45356.)

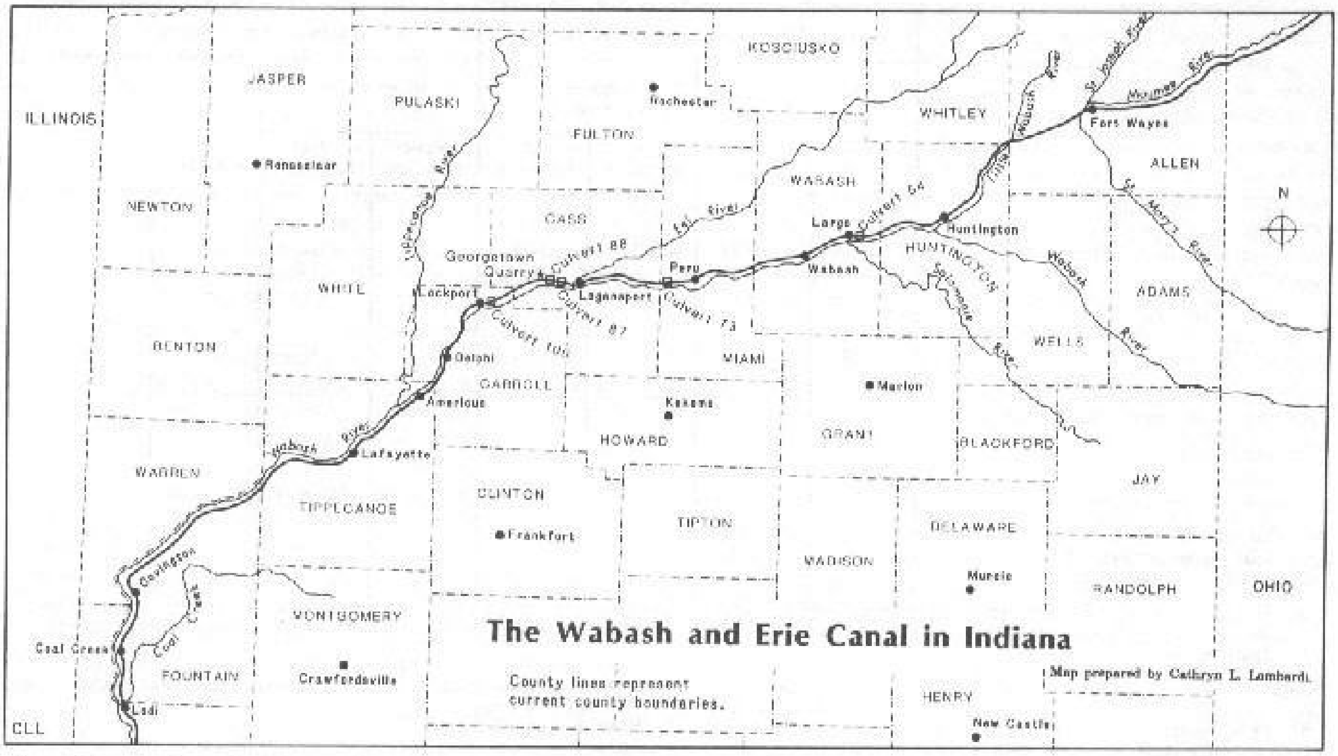
D. & R. CANAL "SWING BRIDGE"



ACS Director Bill McKelvey, Jr. sent us this photo of a "Swing Bridge" model on the Delaware and Raritan Canal. The model was made by Earl W. Cunningham of Somerset, New Jersey, from plans obtained from the Historic American Building Survey of the Kingston Lock and Bridge.

Water Over Water: Hoosier Canal Culverts, 1832-1847

*Dennis K. McDaniel**



A modern student of nineteenth-century technology once observed that the technology of canals has been their least-studied aspect.[1] Works on canals have examined their politics, financing, folklore, and economic impact but nearly ignored technical matters. This paper treats the least-studied aspect of this little-studied technology: canal culverts. Though obscure, the topic is important. Culverts were by far the most frequently used devices to get canals past intersecting streams, a vital task without which there could be no canals.

In the design and construction of a canal there are four primary tasks that an engineer must accomplish: survey a useful route with minimum elevation changes; deal with any unavoidable elevation changes present on the route; guarantee an ample supply of water for the canal; and cross lateral watercourses. The Wabash and Erie Canal, built to connect Lake Erie with the Wabash River, followed the relatively flat valleys of the Maumee and the Wabash. The much shorter Whitewater Canal in southeastern Indiana connected the east-central part of the state at the National Road with the Ohio River. Necessary changes in elevation on these canals were effected by locks which sealed one elevation from another and which served to pass canal boats up or down. The generally low relief of the Maumee, Wabash, and Whitewater valleys meant that no tunnels were required in Indiana, although the Whitewater extension to Cincinnati went through one ridge. The numerous tributaries generally provided ample supplies of water, with occasional exceptions during the dry summer months. All of these aspects of canal construction have frequently been discussed because of their political and economic implications or because of the interesting technical problems they present.

The last engineering problem faced by the builder was to carry the canal across lateral streams, ensuring either separation or controlled mingling of the two lines of water. This subject apparently has seldom been the subject of historical research; certainly no published research exists for Indiana.[2] On the rare occasions that scholars have studied stream-crossing on other canals, they have given their attention to aqueducts.[3] Yet these, interesting as they are, constitute only a small percentage of canal stream-crossing structures for the simple reason that most watercourses are too small to merit such elaborate water-bridges. Indiana's Wabash and Erie, for example, from the Ohio state line over the 195.5 miles of the 1847 survey used in this study, crossed over or through 159 watercourses and only ten required aqueducts. The canal crossed five streams in slack-water pools formed by dams, but the remaining 144 crossings utilized culverts.[4]

It is the problem of canal culverts in Indiana in the period 1832-1847 which is examined here. The methods used to carry Indiana canals of the 1830s and 1840s across lateral streams are surveyed and discussed. Three distinctly different kinds of data are used: archival materials from the 1830s showing with what presuppositions a canal engineer approached the problem; a canal survey report of 1847 showing what was actually constructed on one Indiana waterway during the first round of culvert building; and the results of a recent on-site examination of one particularly well preserved but typical Indiana canal culvert from 1840. These data permit a coherent survey of canal culvert technology in one state during a fifteen-year period of canal construction.

The Hoosier state is an apt subject for such a study because it was far enough west to benefit from the ideas and practices that had earlier been developed in the older part of the nation. Little additional canal building was done west of Indiana, as the entire transportation method was soon rendered economically unviable by the railroad. The men who thought about, designed, and supervised the building of Indiana's canals were themselves the inheritors of several decades of accumulated experience and informal education. But the engineers are not

TABLE I: Solutions for Crossing Lateral Streams with a Canal

Stream Class	Stream Bed Well Below Canal Level				Stream Bed Near Canal Level			
	Suitable Stone Available		Suitable Stone Not Available		Clear Water		Sediment-laden Water	
	Water Required*	Not Required	Water Required	Not Required	Water Required	Not Required	Water Required	Not Required
1. Less water than that passed by a 4 ft. arch. (less than 6.3 ft.^{2} cross-section)	B	C1 C2	B	C2	B	B C2	B**	C2
2a. Water passed by an arch of 4-12 ft. (6.3 ft.^{2}-56.5 ft.^{2} cross-section)	C1***	C1 C2		C2		C2		C2 D
2b. Water passed by an arch of 12-30 ft. (56.5-353 ft.^{2} cross-section)	C1***	C1	C4*** D	C4	D	D	D	D
3. Water requiring an arch of over 30 ft. span. (greater than 353 ft.^{2} cross-section)	A D	A C1 C3	D	C4 D	D	D	D	D

SOURCE: Specifications for Masonry, in Whitewater Canal Papers, Indiana Commission on Public Records, Indiana State Library Building, Indianapolis.

Abbreviations:
A Aqueduct
B Pass stream into canal
C1 Culvert, stone arch
C2 Culvert, wooden box
C3 Culvert, multiple stone arches
C4 Culvert, wooden arch or arches
D Dam and pool

*Sites where engineer calculated additional water was needed for canal
**If basin is large
***With separate feeder

the main focus here; beyond a few names and references to earlier canal experience in states further east, one will find little about the men.[5] Canal culvert technology has center stage.

Nothing can be imagined that is more prosaic than a modern culvert. The simple task of passing relatively small quantities of water under rights-of-way is now inconspicuously managed by metal or pre-cast concrete tubes. In the 1830s, however, at the time Indiana canals were begun, engineers gave substantial attention to the design and installation of culverts, and they developed rules to help them decide when to install a culvert in preference to other structures.

The engineering records of the Wabash and Erie, Indiana's longest canal, have apparently been lost, but the Indiana Commission on Public Records holds the notebooks and drawings of M.S. Webb, an engineer in about 1836-1840 on the Whitewater Canal, then under construction.[6] The narrative sections of his notebooks include guidelines that amount to a canal-builder's handbook. The drawings provide additional information on dimensions and bills of material. Stone-arch culverts are emphasized and wooden culverts slighted. All information is general and not identified with specific sites where culverts were to be built.

Ohio and the older eastern states were the fonts of knowledge for Indiana canal builders. Webb noted, for example, that he had obtained much of his information, especially that on hydraulic calculations, from an Ohio engineer named Cooper. Similarly, Jesse L. Williams, Indiana's chief engineer for all internal improvements and author of the important 1847 Wabash and Erie survey, had come to Indiana from the Ohio canal system in 1832.[7]

M.S. Webb gave his canal rules in narrative form under three headings: (1) General Rules for Crossing Streams; (2) Culverts; and (3) Arched Culverts. The treatment was not systematic. Table I summarizes the solutions he recommended. Note that he did not offer a rule for some cases, but in others he suggested two or three possibilities.

Under "General Rules," Webb described how a canal is to be carried across watercourses according to the varying sizes of the streams. He divided them into three classes according to the maximum amount of water each carried when in flood.[8] The smallest, Class 1, could be accommodated at flood by a semicircular culvert of four-foot chord or span (6.3 square feet in cross-section). The largest, Class 3, had a maximum flow greater than could be passed through a semicircular arch of thirty-foot span (353 square feet in cross-section). Between these extremes fell the middling creeks, which represented the vast majority of all streams encountered in Indiana canal building. For these middle-size (Class 2) watercourses Webb recommended passing the water under the canal by means of a culvert or set of culverts, an answer which, as Table I shows, he recommended less frequently for the largest and smallest streams.

The arrangements designed to cover the mid-range conditions, Classes 2a and 2b in Table I, received most of Webb's attention, but before examining them in detail it may be best to place them in context by examining Webb's solutions for the largest and smallest streams. In most cases he recommended letting the small Class 1 brooks flow directly into the canal, avoiding the trouble and cost of any elaboration at all. His only proviso in such cases was that a sufficient number of waste weirs or overflow outlets be provided nearby so excess water might leave the canal without damaging the banks. If the stream carried so much sand or gravel that it might tend to fill the canal, he indicated that a small culvert should be built to pass the water under the canal.

At the upper end of the scale, Webb wrote that large streams and rivers of Class 3 ought to be crossed by aqueducts because these provided the surest navigation. He described an aqueduct as an especially happy solution when the stream had high banks and the canal therefore passed far above the stream bed. But an aqueduct required that adequate building materials—stone for the piers and wood for the trunk—be close to the site, a distance Webb defined as no more than six to ten miles.[9] If a feeder (additional supply of water for the canal) was necessary or desirable on that section of the canal, a dam could be built on the downstream side of the canal crossing, and the canal itself conducted through the pool formed by the dam. In that case the problem of carrying the towpath over the pool had to be resolved with a towpath bridge, rope ferry, or horse ferry.

When a culvert was the answer, Webb prescribed two distinctly different types depending upon the circumstances: if the culvert could be set very low in its stream bed and if the size of the stream fell toward the lower end of Class 2 (maximum flow passable through a twelve-foot chord semicircular culvert), he recommended an inexpensive wooden rectangular culvert, placed low so as to be permanently under water. Because wood deteriorates when not completely submerged, it was important that not only the bottom, but also the 18-36-inch sides and the horizontal top, be kept under water. This required a nice calculation to assure that there would be sufficient water to maintain this cover, and frequently a small dam was placed across the stream just below the culvert to maintain the water depth.[10] On the other hand, the culvert had to be open enough and to have great enough capacity to handle even spring floods so that the water would not back up and damage or erode the canal embankment. If a wooden rectangular culvert was not suitable because the stream was larger in flood than a twelve-foot arch could handle, or if the stream bed was so far below the level of the canal that insertion of a low, wooden rectangular culvert would leave a high, exposed bank, Webb prescribed a stone arch or in rare circumstances a wooden arch.

The guidelines found in Webb's manuscripts may be compared with Jesse L. Williams's report of the actual structures found on the Wabash and Erie in 1847. Williams examined minutely all the structures on the 189 miles of the canal that had been built since 1832, from the Ohio line to near Coal Creek south of Covington, Indiana, as well as the 6.5 mile St. Joseph feeder.[11] Except for infrequent remarks on the condition of the bank, he concentrated on the dams, bridges, aqueducts, culverts, locks, and waste weirs—the "works of art," in the terminology of the time.

Williams's report is organized differently than Webb's Whitewater notebooks. Williams did not state the quantity of water or flow rate of each stream, nor did he indicate the probable flows in flood-time. He simply reported the location, dimension, and condition of the mechanical structures that he found on the canal. From these data one can only surmise the relative size of each stream from the dimensions of the structure erected upon it, precisely the opposite approach from Webb's *a priori* classification explained above. There can, therefore, be no precise ranking of stream size on the Wabash and Erie that would strictly parallel Webb's Whitewater classifications. The general size of the streams crossed by the Wabash and Erie can be estimated from the 1847 report, but erroneous deductions could be drawn, as, for example, in cases where large arches or even aqueducts might have been put up, not for the quantity of water that they could handle, but to gain height for the canal bed.[12]

Williams concentrated on the elaborate structures and did not necessarily mention the very small brooks of Class 1 that simply flowed into the canal. He did mention the location of moveable-gate waste weirs, and since there were only four or five on the canal not accounted for by proximity to large feeders, one may deduce that there were probably not many other small streams that simply flowed into the canal.[13] Only three non-urban culverts of less than 6.3 square feet of cross section (Webb's Class 1) were found on the Wabash and Erie in 1847; such other streamlets as may have existed at that time apparently fed into the canal. Even the four or five weirs mentioned may not have had any purpose other than general control of water depth since they were used also to drain a canal level whenever maintenance was required.

Williams's report provides complete coverage only for larger streams. Selection of a particular culvert dimension did not necessarily imply a stream of a certain size—there was simply too much latitude, as the rules in Webb's Table I show

TABLE II: Frequency and Method of Crossing Lateral Streams, Wabash and Erie Canal in Indiana, 1847

Cross-section (ft.^{2})	Single Wooden Rectangle (1)	Multiple Wooden Rectangle (2)	Single Wooden Arch (3)	Multiple Wooden Arch (4)	Stone Arch (5)	Multiple Stone Arch (6)	Aqueduct (7)	Dam and Pool (8)	Totals (9)
0-10	29*	...	...	...	...	...	...	...	29
11-20	52	...	1	...	3	...	...	...	56
21-30	11	5	1	...	5	...	...	...	22
31-40	3	5	1	...	1	...	...	...	10
41-50	...	3	...	...	...	...	...	...	3
51-60	...	1	...	...	...	...	...	...	1
61-70	...	1	...	...	...	...	...	...	1
71-80	...	2	...	...	1	...	...	...	3
81-90	...	4	...	...	1	...	...	...	5
91-100	...	2	...	...	...	1	...	...	3
101-200	...	4	1	1	1	...	...	...	7
201-300	...	1	2	...	...	...	...	...	3
301-400	...	...	...	...	1	...	...	...	1
Unknown, large	...	...	...	...	...	...	10**	5	15
Total	95	28	6	1	13	1	10	5	159

SOURCE: Jesse L. Williams, "Report of the Chief Engineer Descriptive of the Condition of the Canal at the Commencement of the Trust," included in "Annual Report of the Trustees of the Wabash and Erie Canal, to the General Assembly of the State of Indiana, December, 1847," in Indiana, *Documents of the General Assembly*. . . . (Indianapolis, 1848), 219-36.

NOTES: * Six were less than 6.3 ft.^{2} in cross-section.
** Spans ranged from 28 to 200 feet, heights above streams unknown, capacity therefore cannot be calculated.

and as the empirically derived information in Table II indicates. The latter provides a breakdown of the classes and types of culverts on the Wabash and Erie in 1847, classifying all the lateral watercourses that Williams thought worth mentioning and providing totals by type and size.

The rarer culvert installations—stone arches, multiple wooden boxes, and wooden arches—occur in a variety of sizes, but they are infrequent in the smaller categories. These relatively complicated styles, however, along with aqueducts and dam/pool crossings, appear at all locations providing more than 40 square feet of cross-sectional capacity.[14] This is no surprise and merely confirms the common-sense expectation that the

TABLE III: Frequency of Culvert Sites with Multiple Wooden Rectangular Openings, Wabash and Erie Canal in Indiana, 1847

Total Cross-Section of Culvert at each Site (ft.²)	Number of Openings				
	2	3	4	5	6
21-30	5				
31-40	4				
41-50	3				
51-60	1				
61-70	1				
71-80	2				
81-90	1	4			
91-100	1	1			
101-200	...	1	2	1	
201-300	...	...	...	...	1
Totals	18	6	2	1	1

SOURCE: Jesse L. Williams, "Report of the Chief Engineer Descriptive of the Condition of the Canal at the Commencement of the Trust," included in "Annual Report of the Trustees of the Wabash and Erie Canal, to the General Assembly of the State of Indiana, December, 1847," in Indiana, *Documents of the General Assembly. . . .* (Indianapolis, 1848), 219-36.

larger the river crossed, the more sophisticated the engineering solution required. Conversely, Table II implies that wherever possible the engineer chose the cheapest and simplest device that he thought would work, with the result that wooden rectangular boxes, single or multiple, carried the canal over three-quarters of the streams, and even over some of apparently large dimension.

Table III amplifies column 2 of Table II by showing how many openings or elements there were at the twenty-eight streams where multiple-box rectangular wooden culverts were built.[15] In some instances these were sizeable installations, as much as 72 feet wide.[16] Wooden rectangular culverts were low and flat, typical dimensions being 10 by 1.5 feet, or 12 by 3 feet in each element. For wooden culverts Webb specified a length of 94 feet under the canal, exclusive of head or wing walls, 6 feet longer than the stone arch culvert tubes which normally had much more elaborate protective head and wing walls. Probably the two types similarly varied in length on the Wabash and Erie.

Metal was rarely used on the Wabash and Erie except in the fittings of the lock gates. However, four rectangular wooden culverts (numbers 112-115) between Delphi and Americus were banded with iron straps to give them added strength against upward pressure when the nearby Wabash River was high. On older canals in the East, iron had sometimes been used for the entire body of the culvert.[17]

There also was a certain variety among stone culverts. One stone culvert, described only as "small," was rectangular. For convenience it has been grouped with the smallest wooden culverts in Table II. And one stone arch culvert had double arches, each eleven feet in span.[18] From a similar extant double culvert in Ohio and from Webb, it is clear that both arches were erected on a common foundation and formed one structure. The only other deviation from standard types on the Wabash and Erie was a small stone arch that sprang from vertical stone walls 2.5 feet high.[19] In later years, this form was very common under railroads.

Greater detail on the stone culverts listed in columns 5 and 6 of Table II is provided in Table IV, but in this table they are listed in geographical order westward from the Ohio border, the numbering method that Williams used. The remarks column shows that during the initial round of construction, until about 1840, almost all stone arches were built of rough material and displayed poor workmanship. The Burnett's Creek arch (number 100), built ca. 1839-1840, is the earliest arch of over ten-foot span described as still in sound condition in 1847. The other three of that size then in good condition—culvert number 1 on the St. Joseph feeder and canal culverts 73 and 88—had been built or rebuilt just before the survey was made; obviously

TABLE IV: Stone Arch Culverts, Wabash and Erie Canal in Indiana, 1847

Culvert Number	Span (ft.)	Cross-Section (ft.²)	Location	Williams's Remarks
1*	13.5	72	Beckett's Run	cut stone, new excellent [built 1845]
27	6	14	Ewing's Warehouse	good condition
48	6	29		2.5 ft. abutments
54	11 ea.	95	Lagro Creek	not of durable quality
60	8	25		rough stone; badly constructed
61	8	26		rough stone; imperfectly built
63	6	14		rough stone; material and workmanship imperfect
73	15	66	La Fontaine's Creek	recently rebuilt from Georgetown cut stone; stone excellent; arch perfect
76	8	25		rough stone
78	6	14		rough stone; imperfect
87	8	25		rough stone; imperfect
88	10	39		built last winter of Georgetown stone; excellent
100	20	157	Burnett's Creek	hammer-dressed stone; good repair except ring stones
132	30	353	Bear Creek	very soft cut sandstone; some doubt of durability; workmanship appears good.

SOURCE: Jesse L. Williams, "Report of the Chief Engineer Descriptive of the Condition of the Canal at the Commencement of the Trust," included in "Annual Report of the Trustees of the Wabash and Erie Canal, to the General Assembly of the State of Indiana, December, 1847," in Indiana, *Documents of the General Assembly. . . .* (Indianapolis, 1848), 219-36.

NOTE: * on St. Joseph feeder; all others on canal itself.

the first versions had been inadequate or they would not have been replaced. Williams's report is peppered with statements alluding to the poor quality of the work, the insecurity of the arches, and the need to rebuild a number of them soon with good cut stone.

The tension between the two opposing philosophies of building quickly and cheaply in order to get the canal into service, or building securely of good stone from the outset, had long been a feature of American canal building. In general, the first method implied construction of locks, culverts, dams, and aqueducts from wood, with the goal of quickly opening the canal and using the revenues generated from operations to

TABLE V. Stone Arch Culvert Dimensions

Span or Chord of Arch (ft.)	Lineal ft. under central portion of arch body. (1)	Length of timbers in col. (1) (ft.). (2)	Lineal ft. under end portions of arch body (near parapet). (3)	Length of timbers in col. (3) (ft.). (4)	Lineal ft. under wings. (5)	Length of timber in col. (5) (ft.). (6)	Thickness of timber (in.). (7)	Length of ring stones (in.). (8)	Depth of ring stones (in.). (9)	Thickness of stone in wings—at ends, and next to arch (ft.). (10)	Radius of circle of wings (ft.). Cf. Fig. 4, bottom. (11)	Length of pilings (ft.). (12)
6	80	11	8	18	12	21	9x10 10	18	15 or 16	...	...	...
7	80	11 ½	6	19 ½	14	23 ½	...	18	...	...	...	...
8	80	12 or 12 ½	8	21	16	25	10 deep	18	16 or 17	3	...	4
10	78	15	10	24	16 18	28 30	10 deep	18	17 or 18	2 3	11'9"	...
10+10	80	28	8	36	18	43	...	...	18	2 2	...	...
12	78	17	10	26	4 16 20	28 31 34 ½	...	21	18 or 19	2 ¼ 2 ¼	11'3"	...
12+12	80	31 ⅛	6	37 ½	6 14	41 ½ 44 ½	9x10	...	19	2 ¼ 3 ¼	11'9"	4
14	...	...	...	...	...	...	...	21	19 or 20	...	...	...
16	74	22	14	35	24	41	...	21	20 or 21	...	...	...
18	76	24	8	31	8 22	38 42	10x 12	24	21 or 22	2'9" 4'3"	...	...
20	...	...	...	...	...	...	...	24	22	...	...	...
20+20	72	48	16	29	16 28 40	33 12 10	10x 12	...	21	4'0" 5'10"	19'10"	5
22	...	...	...	...	...	...	...	27	23	...	...	...
24	68	32	20	45	30	52	...	27	23 or 24	4'0" 5'6"	25'9"	4
26	66	36	22	48	32	54	...	27 or 30	24 or 25	...	...	...
30	...	...	...	...	...	...	...	30	26 or 27	...	...	...
34	...	...	...	...	...	...	...	...	28 or 30	...	...	...
									Burnett's Creek Arch			
19 ½	Cols. 1, 3, and 5 add to 120.66 feet.					±44'10"	...	23 ½	...	... 2'7"	...	...

SOURCE: Specifications for Masonry, in Whitewater Canal Papers, and Plan of Culvert ... 12 Foot Chord, both at Indiana Commission on Public Records, Indiana State Library Building, Indianapolis.

rebuild with stone or to renew repeatedly with wood. Undercapitalized projects relied on this strategy, and immigrant engineers thought it a typically New World trait. But these engineers saw it less as a result of capital shortage than as a psychological characteristic of Americans, a part of the feverish activity of the new United States.

Whether undercapitalization or mere hyperactivity caused the American proclivity for wooden construction, European-trained engineers preferred to build monumentally, in stone, from the beginning, and they were critical of wood. The immigrant Benjamin Henry Latrobe, trained in England and Germany, wrote condescendingly in 1807 and again in 1810 that if his customers wished to build of wood they needed nothing more than a "New England bridge builder."[20] For all that, Latrobe did use wood on the canals and other works that he designed.

Latrobe was long dead when others built the Wabash and Erie Canal, but the conflict between the engineer's desire to build in a manner of which he could be proud and the exigencies of capital shortfall or great hurry were still in evidence in Indiana in the 1830s and 1840s. The problem of financing Indiana's internal improvements lies beyond the scope of this paper, but funds were short, and the people of the Wabash Valley applied great pressure to see that their canal was pushed to rapid completion.[21]

One very practical problem was obtaining suitable stone. When he was building the Chesapeake and Delaware Canal feeder in Maryland in 1804, Latrobe had had part of the canal dug and filled with water and then used the completed section to transport stone.[22] A similar method was used on the Wabash and Erie. This canal did not reach a source of suitable stone until it came to the Georgetown quarry in Cass County. As a result, until that source of good stone was reached southwest of Logansport, wooden culverts went up quickly at sites where they could not long endure or rough stone arches were thrown

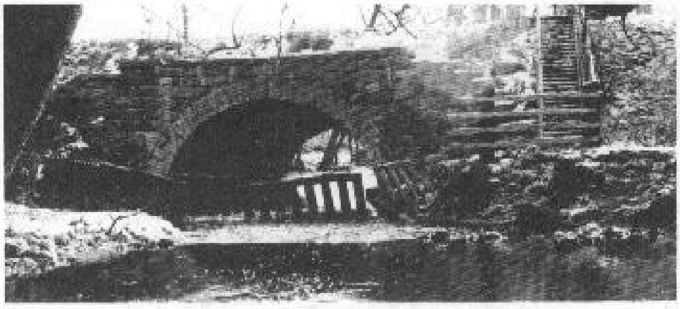


FIGURE 1—BURNETT'S CREEK ARCH, 1974: NORTH PORTAL OF TWENTY-FOOT ARCH CARRYING WABASH AND ERIE CANAL OVER BURNETT'S CREEK, CARROLL COUNTY; BUILT 1839-1840 Courtesy of Author.

up where quality building stone lay too distant to be economically transported by wagon.[23] Once the canal reached the Georgetown quarry, however, stone could be shipped back on the completed canal for distances that had theretofore been uneconomical. Early defective arches and locks could be replaced. The remarks column of Table IV shows that this was done in 1845-1847. Even at that early date, builders shipped stone back as far as LaFontaine's Creek (culvert number 73) in Miami County, about seventeen miles from Georgetown.[24]

The Georgetown quarry sat beside the canal between culverts 88 and 100. Table IV shows that number 100 was not only the earliest large arch still in good shape in 1847, but also that it was the only major arch on the canal built of adequate stone on the first attempt. All the others to that point were either rough and not durable or had been rebuilt just before Williams conducted the survey.

On the Wabash and Erie Williams did not provide specific information on the source of the poor stone used in the arches, although he did comment upon the *locks* built of inferior stone.[25] The raw material for all of these had come from the "Salamania" quarry, and in every instance it was found wanting. The "Salamania" stone locks were distributed over that section of the canal from about the Huntington-Wabash County line westward to near Peru, or approximately where stone arches 54 through 73 were located (see Table IV and Map). In all probability the unsatisfactory stone used in the culverts on that stretch had come from the same quarry. The "Salamania" quarry was apparently located about where part of the Salamonie Reservoir now stands, between Lagro and the Wabash-Huntington County line.

As the foregoing shows, the builders did not easily or quickly accomplish the task of obtaining good stone and employing it in arches on the Wabash and Erie. Few large stone arches existed at any time, and it is remarkable that at least one of the largest original arches has survived until the present day: culvert number 100, the stone arch that carried the canal over Burnett's Creek in Carroll County (Fig. 1).[26]

Nowadays the arch serves as a county road bridge and has been slightly altered and repaired, but in all major respects it stands as it did when completed in 1840.[27] It was the second largest arch built on the canal by 1847, and Williams's remarks show that he found it sound but not in perfect condition when it was seven years old. He reported that some of the ring stones on both ends were "soft" and "falling to pieces," just as they are today, as shown in the photo of the north face (Fig. 2).[28] County workers enveloped the south face in concrete to prevent furthering weakening from the same cause (Fig. 3).[29]

The recent photographs accompanying this article, when compared with Webb's drawings (Figs. 4 and 5), and his data in Tables V and VI (unfortunately fragmentary for twenty-foot arches), show that the engineers built the Burnett's Creek arch upon the same principles and dimensions that Webb prescribed. Further explanation of these tables appears below.

The casual passerby on Towpath Road today might not even notice the arch. The great 85.5 foot length of the culvert makes it in effect a very wide bridge, and it means that a broad expanse of earth extends far from the road's edge on the south side, concealing the creek below. Only by looking down sharply on the north side of the road can one see the stream below.

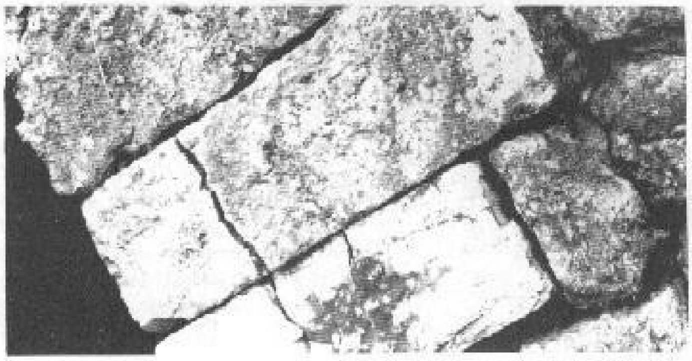


FIGURE 2—CRACKED RING STONES, BURNETT'S CREEK ARCH, 1974: COMPRESSION FRACTURES ARE VISIBLE IN RING STONES ON WEST PART OF THE NORTH PORTAL Courtesy of Author.

The height of the arch in relation to the former canal prism is not easy to determine because the road has replaced the canal bed, but Webb's rule called for a minimum of two feet of earth (called puddle) between the top of the arch stones and the bottom of the canal bed, and this gives an indication of the minimum probable elevation of the canal. Note also Webb's comments in Table I, mandating an arch if the bed of the stream to be crossed lay far below the level of the canal. The site at Burnett's Creek suggests this condition. The fact that the engineer there chose a rather large twenty-foot arch, with its attendant ten-foot rise (in addition to stone thickness and puddle), indicates that the desire to gain height may have motivated him.

Canals sometimes leaked through the stone arches when the clay bed was new.[30] The winter photo (Fig. 6) showing telltale icicles under the arch proves that more than a century of settling has not eliminated this problem at Burnett's Creek.

Tables V and VI bring together large amounts of information scattered in Webb's notes and drawings. For comparative purposes data gathered in a recent survey of the accessible parts of the Burnett's Creek arch appear at the bottom of Table V.[31] The two tables possess detail that may require patience to

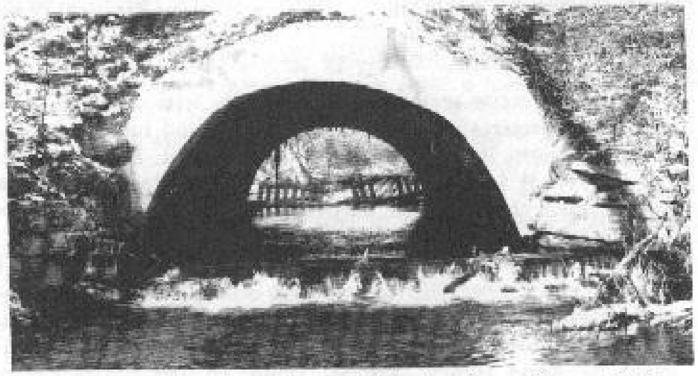


FIGURE 3—BURNETT'S CREEK ARCH, 1974: THE SOUTH PORTAL IS ENCASED IN CONCRETE. VISIBLE IN THE FOREGROUND IS THE SMALL DAM USED TO KEEP THE WATER OVER THE FOUNDATION TIMBERS UNDER THE ARCH. Courtesy of Author.

TABLE VI: Bills of Material for Stone Arch Culverts

Span or Chord of Arch in feet	Total foundation timbers (ft.³) (1)	Total two-inch oak planking (ft.²) (2)	Stone in arch body (yds.³) (3)	Stone in each wing wall (yds.³) (4)	Stone in each parapet (yds.³) (5)	Total stone: 1 arch, 2 parapets, 4 wings (yds.³) (6)	Puddle (yds.³) (7)
6	1060	350 240	...	...	...	72	...
7	1170	...	...	...	...	...	...
8	1313	420 260	72.94	5.60	2.60	100.54	...
10	1625	500 250	...	...	...	131 or 140	150
10+10	...	768 430	...	...	...	...	...
12	1912	520 310	...	...	...	160 or 190	...
12+12	...	860 252	...	...	...	...	...
14	...	...	...	...	...	226	...
16	2590	...	...	...	...	270	...
20	...	...	...	...	...	378	...
20+20	...	1420 500	...	...	...	600	...
22	...	...	...	...	...	481	...
24	4636	...	...	...	...	553	...
30	...	...	...	...	...	727	...

SOURCE: Specifications for Masonry, M.S. Webb Excavation Book, both in Whitewater Canal Papers, Indiana Commission on Public Records, Indiana State Library Building, Indianapolis.

mine. Columns 1-6 of Table V are best understood in reference to Webb's overhead drawing (lower part of Fig. 4), which shows that the foundation timbers must extend ever wider as one moves out from the arch body toward the end of the spreading wing walls. Notice that in every case (except for possible scribal errors in the 12+12- and 18-foot rows), columns 1 and 3 add to 88 feet, the specified normal length for an arch body. Beyond the basic 88 feet, the extent of the timber foundation is positively correlated with the length and spread of the wing walls, which is in turn positively correlated to the span or chord of the arch.

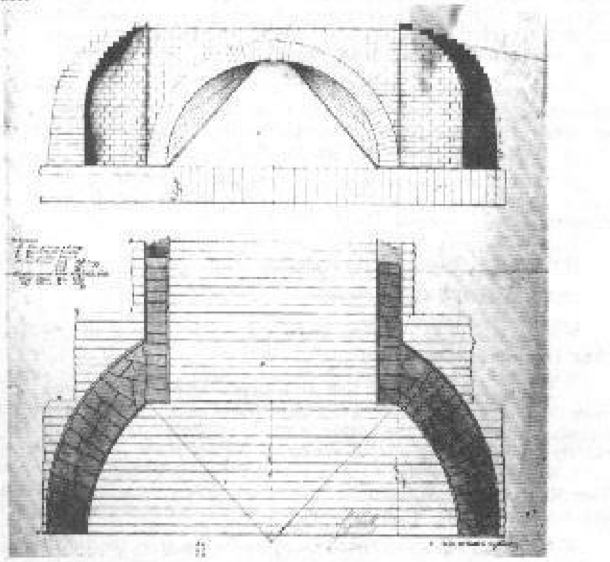


FIGURE 4—"CULVERT 24 FEET CHORD": DRAWINGS BY M.S. WEBB, WHITEWATER CANAL ENGINEER, CA 1839

Courtesy Indiana Commission on Public Records

To understand this idea, one may take as an example the data for the 12-foot arch, which are interpreted as follows: from the inside mid-point of the culvert, 39 feet (half of 78) in each direction was undergirded by foundation timbers 17 feet long laid transversely to the arch body. Then beyond that there were 5 feet under each parapet of timbers 28 feet long, then for 2 more feet there were also 28-foot timbers where the wings began to extend from the parapet, then a further 8 feet of 31-foot timbers and finally, for the last 10 feet there were 34.5-foot beams reaching across to support the furthest extremities of the wing walls. In every case the timbers extended completely across the stream and tied together both sides of the arch and both wing walls. The overall result was a large, hourglass-shaped platform of wood supporting all the masonry.

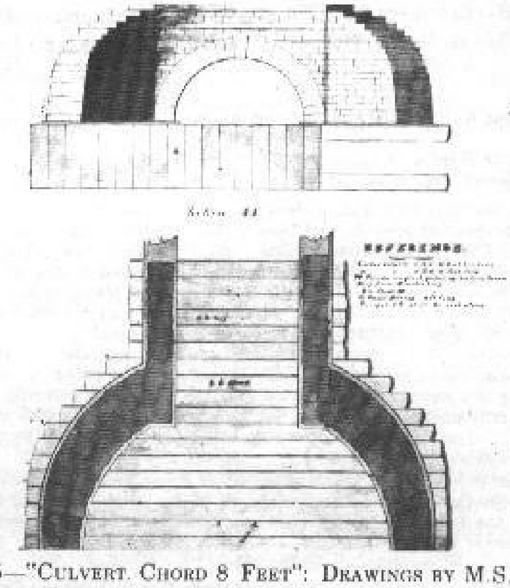


FIGURE 5—"CULVERT. CHORD 8 FEET": DRAWINGS BY M.S. WEBB, WHITEWATER CANAL ENGINEER, CA. 1839.

Courtesy Indiana Commission on Public Records

Webb did not amplify certain bits of data contained in Tables V and VI. For example, builders apparently drove the pilings listed in Column 12 of Table V only near the ends of the horizontal foundation timbers. Figures 4 and 5 at least lead to that conclusion.

Also unclear are the two quantitites Webb gave for the two-inch oak planking (Table VI, column 2). Apparently these two numbers are added in each case, since elsewhere he said that a ten-foot arch required 750 square feet of oak planking.

As is well known, the Indiana canal system was an economic failure. The large sums expended upon it were not recouped directly in tolls and fees and probably not indirectly in economic benefits, although the Wabash and Erie did for a time lower the shipping costs of Hoosier farm products headed for market. This brief period of efflorescence was from about 1847 until 1856.[32] The much shorter Whitewater provided some of the same benefits on an even more modest scale in about the same period.

The principal purpose of this paper has been to describe and summarize canal culvert technology of the mid-nineteenth century. A second purpose has been to draw attention to the historical value and aesthetic appeal of a little-known but impressive monument to early Indiana engineering. The Burnett's Creek arch stands and serves—cared for by Carroll County and marked by the Carroll County Historical Society—as a valued physical reminder of early canal development in Indiana during the era of the internal improvements mania.

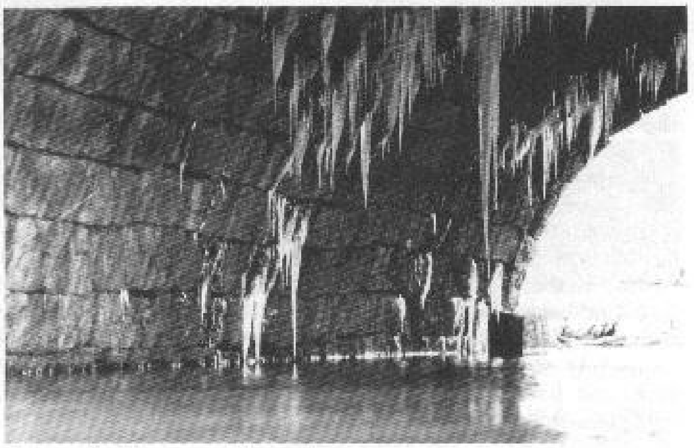


FIGURE 6—BURNETT'S CREEK ARCH, 1974: VIEW LOOKING NORTH FROM WATER LEVEL INSIDE THE ARCH, SHOWING ICICLES AND COURSES OF STONE

Courtesy of Author

* Dennis K. McDaniel is director of the Peale Museum in Baltimore, Maryland.

[1] Brooke Hindle, *Technology in Early America: Needs and Opportunities for Study* (Chapel Hill, 1966), 56.

[2] For example, Paul Fatout, *Indiana Canals* (West Lafayette, Ind., 1972), has no discussion of culverts, and Dora T. Mayhill, *Old Wabash and Erie Canal in Carroll County* (Knightstown, Ind., 1953) mentions two culverts only in passing. An exception, dealing with the eastern United States, is Thomas F. Hahn, *Towpath Guide to the Chesapeake and Ohio Canal* (4 parts; Shepherdstown, W.V., 1971-1978), which measures and describes extant culverts and all other structures and features on that canal.

[3] Culverts and aqueducts may be differentiated as follows: a culvert is a stone, wood, concrete, or metal tube carrying water under or through the foundation of a right-of-way, while an aqueduct is a bridge carrying water over an essentially undisturbed stream, railroad, or road. A stone arch culvert may be thought of as a very wide, (usually) single-span stone bridge of the type which has existed since antiquity.

[4] Jesse L. Williams, "Report of the Chief Engineer Descriptive of the Condition of the Canal at the Commencement of the Trust," included in "Annual Report of the Trustees of the Wabash and Erie Canal, to the General Assembly of the State of Indiana, December, 1847," in Indiana, *Documents of the General Assembly. . . .* (Indianapolis, 1848), 213-37.

[5] The best background on the men is David Hovey Calhoun's *The American Civil Engineer: Origins and Conflict* (Cambridge, Mass., 1960). Jesse L. Williams (1807-1886) is virtually the only Indiana engineer about whom information is available.

[6] Specifications for Masonry; M.S. Webb Excavation Book; and Engineer's Pocketbook 1837-1840, in Whitewater Canal Papers (Indiana Commission on Public Records, Indiana State Library Building, Indianapolis). My thanks to Steve Novak for their initial survey. M.S. Webb, Culvert Drawings (Indiana Commission on Public Records). Webb's exact job title remains unclear, and little is known about him. He was apparently one of the twelve resident engineers, seven senior assistant engineers, or eleven junior assistant engineers reportedly at work on the Whitewater in 1837; see James M. Miller, "The Whitewater Canal," *Indiana Magazine of History*, III (September, 1907), 111-12.

[7] Williams had surveyed for the Whitewater in 1834; Esarey, *Internal Improvements*, 93; Poinsatte, *Fort Wayne During the Canal Era*, 39; Frank Trevorrow, *Ohio's Canals* (n.p., 1973), 72-74. For a discussion of "on the job training" in this field, see Calhoun, *American Civil Engineer*, 47-53.

[8] There are other ways of thinking about the problem. The French engineer Joseph-Mathieu Sganzin, for example, described the possibilities as passage of the other stream over, under, or through the canal. The 'over' solution was neither discussed nor carried out in Indiana. Joseph-Mathieu Sganzin, *Programme ou Resumé des Leçons d'un Cours de Constructions*, 4th ed. (3 vols., Paris, 1839-1841), II, 126. A modern irrigation canal treatise says, "Storm and drainage water must be controlled to prevent erosion of the uphill canal bank, and accompanying silting of the canal prism. Storm and drainage water must have either: (1) controlled entrance into the canal through a drain inlet; (2) controlled conveyance over the canal in an overchute; (3) controlled conveyance under the canal through a culvert; or (4) the canal must be routed under the cross-drainage channel in a siphon." The last is of course not possible on a navigation canal. U.S. Department of the Interior, Bureau of Reclamation, *Design of Small Canal Structures* (Denver, 1978), 179.

[9] Webb did not mention all-stone aqueducts, although in the East there were many, with arches up to ninety feet; Hahn, *Guide to C & O, passim*.

[10] A similar small dam, which was used in conjunction with a stone arch culvert, appears incidentally in Fig. 3. It ensures that water will cover the horizontal wooden foundation that underlies the spring points and entire stream bed at this stone arch site.

[11] For a map of the St. Joseph feeder, see Poinsatte, *Fort Wayne During the Canal Era*, 42.

[12] Canal hydraulic arrangements could not be fixed permanently. As settlers cleared the Wabash Valley lands the quantity of runoff increased and its timing changed. Williams commented that greater spring floods occurred as the valley was settled, while summertime flows decreased noticeably; Williams, "Report of the Chief Engineer," 215. The result was that over time canal mechanical structures might have to be enlarged, combined, or abandoned.

[13] A search produced no photos of waste gates or weirs from Indiana, but for photos of a weir from the East see William J. McKelvey, Jr., *The Delaware & Raritan Canal: A Pictorial History* (York, Pa., 1975), 41.

[14] No detailed descriptions, drawings, or photos of wooden arches have been unearthed. The clearest information appears in Williams's description ("Report of the Chief Engineer," 222) of culvert number 36 over Cow Creek in eastern Huntington County: "This is a large wooden arch of 18 feet chord, semicirc[u]lar. A structure of this size and shape could not be submerged, and the arch timbers have therefore been exposed to the air. Experience shows however, that timber thus situated under a moist bank of earth, is not subject to rapid decay, and it is bel[i]eved that this arch may stand 3 or 4 years longer, when it should be rebuilt of cut stone. The head walls will need some repairs within two years."

[15] Multiple wooden culverts were not mentioned by Webb, either in rectangular or arch form. He did say, however, that it was possible to substitute a wooden semicircular arch for a stone one where that form was required but no suitable stone was available.

[16] Culvert number 14, made of six 12-by-3-foot elements, just west of New Haven, Allen County, carrying Six Mile Creek; Williams, "Report of the Chief Engineer," 220.

[17] Williams, "Report of the Chief Engineer," 231; *A View of the Grand Canal* [Erie Canal] *from Lake Erie to the Hudson River* (New York, 1825), 13.

[18] Webb's table of proportions and materials included provisions for such structures. See Tables V and VI where they are denoted, e.g., 10+10. For a larger 1843 twin stone arch at Turtle Creek, Shelby County, Ohio, twenty-two feet in each span, still standing but in danger of imminent collapse, see Trevorrow, *Ohio's Canals*, 51.

[19] There are a few examples on the C & O; see Hahn, *Guide to C & O*, Section 4, miles 114.21-121.19.

[20] Quoted in Darwin H. Stapleton, ed., *The Engineering Drawings of Benjamin Henry Latrobe* (New Haven, 1980), 26-27, 64-65.

[21] Consider the following from 1845: "Having lived for the last seven years in a community whose only sentiment and only hope was the completion of this canal . . . every possible effort was made to hurry forward the work. . . . "; Jos. H. Nelson, "Report of the Chief Engineer of the Wabash and Erie Canal," included in "Report of the Superintendent of the Wabash and Erie Canal, to the General Assembly, December 1, 1845," in Indiana, *Documents of the General Assembly. . . .* (Indianapolis, 1845), 143.

[22] Stapleton, ed., *Engineering Drawings of Latrobe*, 15.

[23] The Georgetown quarry is now the site of France Park, a Cass County park located on the property of the former France Stone Company, Inc. The present hamlet of Georgetown is 2.5 miles southwest, immediately on the banks of the Wabash.

[24] LaFontaine's Creek is now called Edwards Ditch or Prairie Ditch.

[25] Williams, "Report of the Chief Engineer," 225-27, concerning Locks 12-20. As late as 1843 not all officials on the canal realized that Salamonie (Lagro) stone was unsuitable. In that year Commissioner Fisher wrote that the St. Mary's aqueduct piers and abutments ought to be rebuilt with stone from "Lagro"; see S. Fisher, "Report of the Commissioner of the Wabash and Erie Canal East of the Tippecanoe River," in Indiana, *Documents of the Senate. . . .* (Indianapolis, 1843), 20.

[26] Burrows, Indiana, Quadrangle, 1:24,000, Universal Transverse Mercator Kilometric Grid Coordinates: 363056; located on Towpath Road, 0.33 miles northeast of Lockport, about four miles north of Rockfield on the north side of the Wabash River; Williams, "Report of the Chief Engineer," 229.

[27] "Structure Inventory and Appraisal Sheet," Carroll County Bridge Number 26, dated January 12, 1975 [?], provided by courtesy of Charles J. Ritzler, Carroll County Surveyor, Delphi, Indiana.

[28] Williams, "Report of the Chief Engineer," 229.

[29] "Structure Inventory Sheet."

[30] Williams, "Report of the Chief Engineer," 228; *re* culvert number 67, "The arch leaks considerably. . . ."

[31] The measurements at Burnett's Creek were made in August, 1977, and were impeded by the presence of a large coiled snake. Though it was probably a harmless black snake, the author is not herpetologist enough to know whether the creature could be safely overstepped. He wishes to thank his wife and his aunt for holding the tape even in the near presence of the reptile. Canal buff Tom Hahn has pointed out that winter is the best time to explore and photograph old canal beds; in that season one avoids snakes, poison ivy, and foliage.

[32] Elbert Jay Benton, *The Wabash Trade Route in the Development of the Old Northwest* (Baltimore, 1903), 76. This book's evaluation of the Wabash and Erie's economic impact has not been surpassed.

Reprinted (by special arrangement) from the INDIANA MAGAZINE OF HISTORY, December 1982.