AMERICAN CANALS

BULLETIN OF
THE AMERICAN CANAL SOCIETY

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NEW YORK MARITIME EXHIBIT

Miss New York, Vonabell Roocke, poses with ACS Director, Bill McKelvey at the New York Harbor Festival Exhibition grand opening at the World Trade Center. The special Maritime Exhibition was sponsored by the American Bureau of Shipping as a prelude to the gala Harbor Festival 1979. The keystone event of the Festival was the great parade of ships which took place on Saturday, June 30th, when fifty vessels representing every aspect of the ship world sailed from the George Washington Bridge to The Verrazano Narrows Bridge. The armada included a selection of liners, cargo ships, windjammers, harbor craft and military vessels. Topping the most diverse assembly of ships were seven of the world's great cruise ships, led by the 180' coastwise cruiser INDEPENDence and concluded by P & O's 820' S.S. CANBERRA, the world's second largest passenger liner. The INDEPENDENCE of Haddam, CT, operated by American Cruise Lines, Inc., regularly transits the Cape Cod Canal, Cape May Canal, Chesapeake and Delaware Canal, Albemarle and Chesapeake Canal, and the entire Intracoastal waterway to and including Florida's St. Lucie and Caloosahatchee Canals.

Workers Accidently Pull Plug, Drain Canal in England

LONDON (UPI), August 17, 1978 – Workmen accidently pulled the plug and a mile and a half of the Chesterfield Canal went down the drain.

A dredging team was busily removing old bikes, car parts and other odds and ends from the 10-foot-deep canal when they came across a length of chain that wouldn't budge.

The crew attached it to their dredger and yanked. Then they took a break for tea.

When they came back, the water was gone.

"I've never seen anything like it," said waterways foreman John Rothwell. "The wooden block (on the end of the chain) was a plug and we pulled it out."

The canal water drained away into the nearby Idle River.

NEW SHOREHAM II

A new mini-cruise ship, NEW SHOREHAM II, is under construction at Blount Marine, Warren, R.I. She is being built for American Canadian Line, will be 150-feet long, carry a working crew of 12, and have 35 deluxe cabins on three decks. She replaces NEW SHOREHAM, which has been sold. According to Blount she will be the first vessel in the world to recycle waste water. When she begins service this fall in Canada and the Bahamas, she will be the only cruise ship under the American flag operating in the Caribbean. NEW SHOREHAM II will be able to navigate waters such as the Erie Canal by lowering her topmost superstructure, and with a six-foot maximum draft she will be able to call at every city on the Atlantic and Gulf coast. Bill Ewen, Jr., contributor.

The NEW SHOREHAM is to be renamed the GLACIER BAY EXPLORER and is scheduled to operate next summer in a new overnight cruise service between Juneau and Glacier Bay, Alaska. (Submitted by Bill McKelvey from "STEAMBOAT BILL".)

PRESIDENT'S MESSAGE

Thanks to some excellent planning on the part of our Canadian Director – Lou Cahill, his able assistant, Colin Duquemin, and in fact the entire committee in St. Catharines – our tour of the four Welland Canals in September was an event we will long remember. In spite of heavy rains in the area the day before, our Tour Day dawned to an almost cloudless sky – ideal for photo-taking. With heavy attendance from our co-sponsors, the Marine Historical Society of Detroit, as well as members of the local welcoming committee, we had approximately 120 people attending the various events of the three-day week-end. It was the most enjoyable, and certainly the most successful affair that the American Canal Society has ever sponsored.

Ruth and I returned a few weeks ago from a brief fall tour of France and Switzerland. Imagine our surprise while riding a French train between Paris and Lyon, to spot a canal running for miles along our route (parallel to the rivers Armancon and Yonne). I was able to get a few photos of the canal locks and channels as the train sped along, and our appetite is whetted to go back and tour the French canals more carefully!

Our list of ACS LIFE MEMBERS continues to grow – a few names added to the list recently include Dr. Bill Trout (ACS Vice President) of Duarte, California; William G. Tumbridge of Fayetteville, New York; William J. McKelvey Jr. (ACS Director) of Bloomfield, New Jersey; Ralph S. Misener of St. Catharines, Ontario; and Charlie Derr (ACS Secretary) of Freemansburg, Pennsylvania. We hope others will take advantage of this "one-time" dues payment of $100, assuring them a permanent place on our mailing list and the avoidance of future dues increases.

We take this opportunity to send all of you greetings for the coming Holiday Season, and wish you a Happy and Successful New Year!

Bill Shank

New River Buffs Association

An organization of interest to our members in West Virginia and Pennsylvania has recently formed: the Monongahela River Buffs Association. It publishes a well-illustrated 11" x 14" tabloid newsletter called the "VOICE OF THE MON", which includes much of interest to canal buffs concerning the history of the old Monongahela Navigation Company, prior to its take-over by the Army Corps of Engineers. Membership in the organization, including subscription to "Voice of the Mon", is $5, payable to the Monongahela River Buffs Assn., the Monon Center River Museum, P. O. Box 330, Greensboro, Pa. 15338. (William P. Young is Chairman.)

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 $8.00. Individual copies may be purchased at $2.00.

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ILLINOIS & MICHIGAN GRANT

The Department of the Interior has granted $113,555 to the Illinois Department of Conservation to be used for the restoration of Lock #14 of the Illinois-Michigan Canal at LaSalle, Illinois. State funds will match the federal grant. Designed in the 1830s, it was one of 15 numbered locks on the main line of the canal. Plans for the Lock #14 project, scheduled for completion in two years, include the accurate reconstruction of the lock's four wooden gates, plus restoration of its stone masonry walls and oak flooring. The work will require the recovery and use of 19th century building techniques.

Much of the work on the lock will be based on the research of Conservation Department Assistant District Historian Peter Rathbun and the DOC's Canal Interpreter Mary Rathbun. Industrial archeology recommendations were made by industrial archeologist Tom Hahn, a consultant to the project.

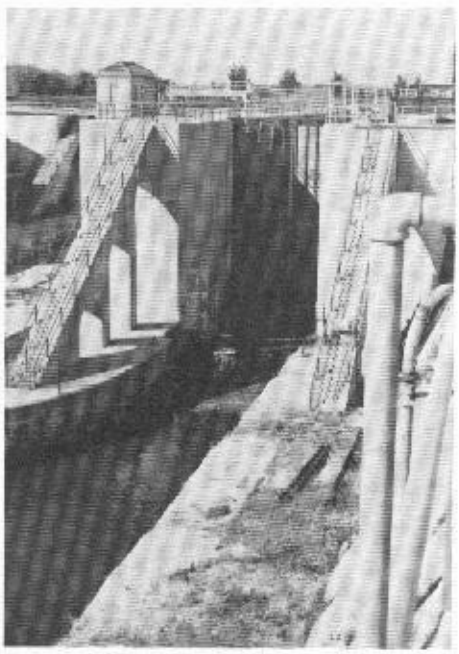
Chicago, Ottawa, LaSalle, and Joliet are four Illinois cities that owe much of their growth to the Illinois-Michigan Canal. Extending from the south branch of the Chicago River at Bridgeport to the Illinois River at LaSalle, the 96-mile canal placed Chicago on a continuous waterway stretching from New York to the Mississippi River. When the Illinois Waterway opened in 1933, the I & M was closed to navigation.

When fully restored and operable, Lock #14 will become part of the interpretive program on the I & M Canal State Trail; the trail will extend approximately 62 miles along the canal's towpath between Joliet and LaSalle. (Adapted from Illinois Dept. of Conservation "**News**"; submitted by Joe Taylor).

Sanitary and Ship Canal Lock

Illinois Canal Society members at a Sanitary and Ship Canal Lock at Lockport, Illinois.

Members of the Illinois Canal Society recently visited a lock on the Sanitary and Ship Canal at Lockport, Illinois. The lock was built in 1907 and has a forty foot lift; it is 22 feet wide and 117 feet long. Although slightly larger than an Ill. and Mich. Canal lock it was designed to allow Ill. and Michigan Canal boats to go from the Sanitary and Ship Canal to the Illinois and Michigan Canal. It has wooden lock gates, which were operated by electricity generated in the neighboring plant. It was in operation until the 1940's, located right adjacent to the Lockport Lock on the Illinois Waterway. When it was built in 1932 it was the largest mitre gate lock in the world; it has since fallen from the position. (Information and photos submitted by John Lamb, President, Illinois Canal Society.)



The lower end of the lock connecting the Illinois and Michigan Canal and the Sanitary and Ship Canal. Note wooden mitre gate at the lower end of the lock.

KNOW YOUR ACS OFFICERS

The subject of our column in this issue is our ACS Vice President, Dr. Bill Trout. Looking over Bill's resumé, it is difficult to know just what to single out about this very talented fellow. In his professional field of Genetics, he is well known for the dozens of articles he has published in various magazines covering his field. He is presently a Research Scientist in the Department of Biology at the City of Hope National Medical Center in Duarte, California, a position he has held since completing his NIH Post-Doctoral Fellowship in the Biology Division of the Oak Ridge National Laboratory in Tennessee in 1966.

To go back a bit further, he obtained his B. S. in Biology at University of Richmond in 1959; his A.M. in Zoology at Indiana University in 1964; and his PhD in Genetics at Indiana U. in 1965. He was Beta Beta Beta in Biology; Pi Mu Epsilon in Mathematics; and has subsequently been listed in "Who's Who in the West"; "American Men and Women of Science"; "Who's Who in the USA"; "Personalities in the West and Midwest"; and "Notable Americans of 1976-77".

But Dr. Bill's extra-curricular activity has been **CANALS** ever since he hiked the old towpath of the James River and Kanawha Canal as a Boy

Dr. William E. Trout III

Scout, and tried (without success) to find someone who knew something about the J.R. & K. Since then, he has done his own research on the 1000 miles of historic canals and waterways of Virginia, and has branched out from his native state to examine (in great detail and by personal visits) some of the most interesting old canals in the United States, Canada, Europe and the Far East. Today, there is scarcely a canal anywhere in the world that Bill Trout can't tell you about. Bill Trout holds memberships in twenty different canal societies and approximately thirty historical, archeological, or environmental societies or associations in the United States and England.

He has commissioned paintings, canal boat models, lock models and other canal-related artifacts for display in Virginia and California; has placed the Rapidan Dam Canal and the Cat Rock Sluice on the National Register; has assisted various Virginia agencies with their plans for canal parks and has initiated the establishment of the Baille-Grohman Canal Trail in British Columbia. He has written thirty-five feature articles on various canals for maritime publications throughout the United States and Great Britain and at least forty major articles in our own **AMERICAN CANALS** quarterly. He was one of the three founders of the American Canal Society in 1972 and its first Treasurer. If there were ever a title of "Mr. Canal-USA" awarded to anyone, Bill Trout would be our candidate!

THE PAW PAW TUNNEL

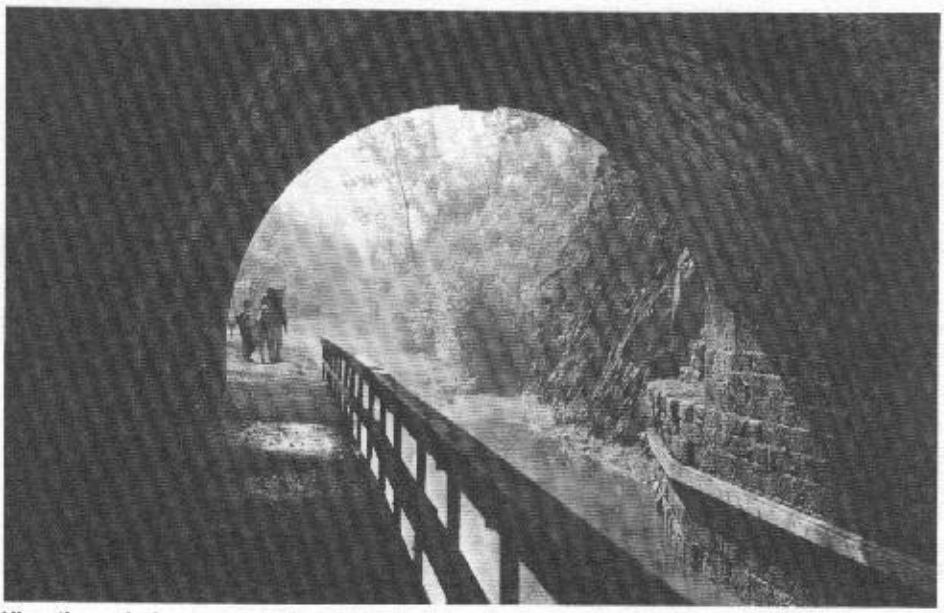
By Thomas F. Hahn

The Paw Paw Tunnel is the major feature of the **Chesapeake and Ohio Canal**, built as a bypass to some very difficult terrain along the Potomac River in the Paw Paw Bends. Here the river makes a series of gargantuan loops; the tunnel route cutting across a large double loop extends one mile where the river travels 5.4 miles. While the tunnel route involved cutting thru 3,118 feet of solid rock the Maryland shore along the river route contains some impressive cliffs coming right down to the river. To have followed the river with the canal would have required either a crossing to the West Virginia shore and back and hacking out the canal along those cliffs; damming the river at the lower end of the bend to form a slackwater and cutting a towpath along the cliffs; or putting the towpath on the West Virginia side of the river.

The alternatives were thoroughly debated within the canal company and, due largely to the enthusiastic advocacy of their newly-appointed engineer, Charles B. Fisk, the tunnel plan won. Even when work was well advanced the board of directors seriously contemplated the abandonment of the partially-completed tunnel in favor of a dam. A decision was made to proceed with the tunnel in February 1836, with the completion date set for July 1838. In actual fact, the tunnel was not completed until 1850, though it was holed thru in 1840. Two other men responsible for building of the tunnel were Fisk's assistant, Elwood Morris and the general contractor, Lee Montgomery.

Montgomery, a Methodist minister with previous tunnel-building experience (he built a 729-foot tunnel on the Union Canal near Lebanon, Pennsylvania), contracted to build the tunnel in the spring of 1836. He appears to have been a rough, tough customer, but energetic and not unimaginative. Bricks were scarce in the area, so he brought in a patented brickmaking machine from Baltimore and set up his own brick works, unsuccessfully though it turned out. Much of the tunneling work involved cutting through rock and the construction of sophisticated brickwork and masonry. The Irish laborers who built much of the canal were not particularly skilled in some of the things to be done, so Montgomery brought in English masons and English and Welsh miners and local Pennsylvania and Maryland "Dutch" masons and laborers.

Those moves, rational as they seemed, were later to contribute to his downfall. Montgomery accepted the contract at much too low a cost. On all sides the optimism was great as to the ease and speed with which the job could be done. The rock formation through which the tunnel was to be dug was a natural arch of shale, thought to protect against cave-ins; the same formations easily slid and drastically slowed the work. It was estimated early that "a single hand can bore from seven to eight-feet per day . . ." whereas in actual fact the rate of progress for an entire crew at each tunnel face was 10-12 feet per week. The tunnel was a large undertaking, employing up to 44 men at a time.



View through the upstream (south) portal of the tunnel. Note the towpath to the left with its railing to prevent the mules from falling overboard. (Photo by Alan Franklin)

Morris played a significant part as the principal liaison between the canal company and the contractor, Montgomery was not around at the finish. Against all sorts of odds, some of his own making, Montgomery succeeded in driving the tunnel through, though not in finishing the entire job. Grossly overextending his credit, he was finally caught in one of the periodic financial crises of the canal company and went under. The tunnel he had built was acclaimed "A Wonder of the World," while he was tossed aside, a sacrifice to creditors to whom he had indebted himself trying to fulfill his contract.

During 1836 there were riots among Irish laborers working on other portions of the canal, but Montgomery managed to keep his work force going without interruption. In early 1836, however, unrest among his own men over the pay situation and rivalries among the various national groups finally exploded into violence. The Irish terrorized work camps and drove off British workers for a time. More riots occured in 1838, Irish versus English and "Dutch." The tavern at Oldtown was destroyed and workmen's shanties were burned. A general strike occurred in May, 1838, along the whole line of the canal, based on failure of contractors to meet payrolls. Local militia, who by this time strongly sympathized with the workers, turned out reluctantly to restore order. Montgomery fired and blacklisted 130 men and work was resumed. More rioting broke out in 1839, this time at Little Orleans and once again the militia was called in.

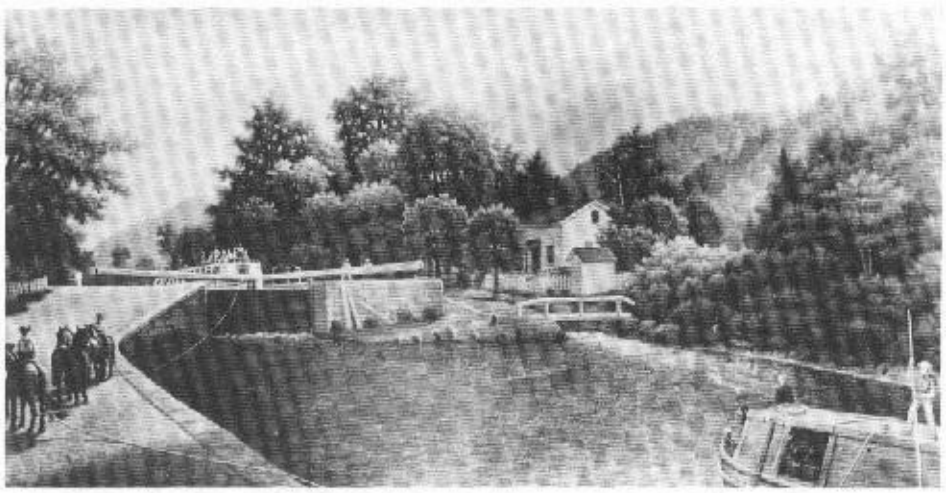
Somehow, despite failing finances and violent unrest, work continued through 1840 and 1841, but in 1842 the canal company collapsed and work on the entire canal ceased. The canal was completed and operating up to Dam Number Six, about 20 miles below the tunnel. In addition, much of the stretch above the tunnel to Cumberland had been finished. Montgomery, who now disappeared in a maze of lawsuits, his personal fortune sunk in the abortive attempt to finish the tunnel, had actually driven it through, but a great deal of work remained. North of the tunnel the deep cut, plagued by a slide, was not fully cleared, and the canal in this cut also had to be completed. The tunnel itself was not yet completed and still had to have brick lining installed. Morris found that Montgomery and his patented machine made poor bricks. Fortunately means were found to raise enough money to resume work under a new contractor in 1847. The tunnel and canal were finished and opened to traffic in October 1850.

The construction was an impressive feat. It involved not only 3,118 feet of tunnel, but also 200 feet of deep cut at the southern end and 890 feet at the northern. In order to speed up the work, two sets of vertical shafts (one at 122 feet and one at 188 feet) were dug down from the hill overhead (two shafts per set to provide ventilation) until the tunnel level was reached, and then digging was carried out in each direction.

(Continued on Page Seven)

An interesting "posed" photo of the Excursion Boat OAK SPRING entering the north portal of the Paw Paw Tunnel. Passengers must have been more agile in those days, as evidenced by the crowd atop the masonry sill.

CANAL DEVELOPMENT IN EARLY AMERICA (Part 2)



Typical mitre-gate lock on one of the canals of northeastern USA, circa 1850. A packet boat is shown in the lock, headed downstream, while a freight boat waits at the right. Thought to be the work of Canal-Artist George W. Storm. (Courtesy of Richard Steinmetz, Sr.)

By Richard G. Waugh, Jr.

Despite the interest and encouragement of such prominent American figures as George Washington and Ben Franklin, the Federal government made little investment in the early canals. From 1786 to 1851, there were no government canals.

The earliest expression of interest in canals by the United States Congress was the Act of 16 March 1804, whereby the Congress assented to the improvement of the James River in Virginia. Then, as mentioned heretofore, in 1809 the Congress appropriated $25,000 for improvements to the Carondelet Canal. By the general survey act of 30 April 1824, the Congress appropriated funds for surveys on roads and canals. Under this authority, the Corps of Engineers of the United States Army conducted most of the major waterway surveys in this country. The next year, the Congress took its most direct interest in canals by subscribing to the stock of the Chesapeake and Delaware Canal Company. Between 1825 and 1851, the Congress bought stock in this company and three others – the Louisville and Portland Canal on the Ohio River, The Dismal Swamp Canal in Virginia, and the Chesapeake and Ohio Canal in the District of Columbia and Maryland – at a cost of $1,285,000.

Apparently, the Congress was satisfied that canal construction was proceeding well enough without intervention from the Federal government. To encourage construction by states, the Congress granted land to them specifically for canal construction. Between 1827 and 1848, Indiana, Ohio, Illinois, and Wisconsin received a total of 2,967,000 acres to build the Wabash and Erie, Miami and Ohio, and Illinois and Michigan canals. Later, the Congress granted an additional 1,450,000 acres to Wisconsin and Michigan, mainly for ship canals on the Great Lakes.

From 1809 to 1838, the Congress provided direct appropriations of $2,262,000 for specific canal improvements, but then no more until 1845, when it appropriated only $5,000. No further appropriations were made for canals until 1864.

Even later than the period under consideration, Federal ownership of canals was minimal. In 1908, there were still 2,189 miles of canals in operation, of which only 194 miles were Federally-owned, 1,359 miles were State-owned, and 636 miles were privately-owned.

MAJOR ENGINEERING FEATS TO 1851

In order to compare the worth of the several canals built up to 1851, it is useful to categorize them by distinctive engineering features that display the difficulty of construction. In the following sections, major parameters are discussed.

Longest Canals.

The longest of the early waterways was the great Erie Canal, completed in 1826 over a distance of 363 miles from Albany to Buffalo, New York. Much later, in 1851, the Wabash and Erie Canal became the country's longest main line canal, covering 379 miles in Indiana from Evansville on the Ohio River to the Ohio State line, and then 18.5 miles in Ohio to the junction with the Miami and Erie Canal near Defiance, Ohio. With the Miami and Erie connection, this route provided a connection from the Ohio River to Lake Erie at Toledo, 465 miles long.

Canal Steepness.

Some canals were relatively short but extremely steep in ascent and descent, thereby requiring a great number of locks. An example is the record for steepness – the Crooked Lake Branch Canal of the New York State system. Crooked Lake Canal was only 8 miles long, but required 27 locks to overcome a lift of 278 feet.

Two canals – the Crooked Lake and Black River in New York – required more than three locks per mile. One other canal required more than two locks per mile – the Chemung. It is interesting to note that all three were part of the New York State system.

Twenty Longest Canals

Canal	Length (Miles)
Wabash & Erie, Ind. & O.	387.5
Erie, N.Y.	363.0
Ohio & Erie, O.	309.0
Penna. Main Line, Pa.	276.7
Miami & Erie, O.	246.8
Chesapeake & Ohio, Md. & D.C.	184.5
Schuylkill Nav., Pa.	108.4
Delaware & Hudson, N.Y. & Pa.	108.0
Genesee Valley, N.Y.	102.0
Erie Extension, Pa.	100.0
Upper N. Branch, Pa.	102.0
Morris, N.J.	102.4
Illinois & Michigan, Ill.	97.2
Cayuga, N.Y.	97.0
Ohio & Penna., O.	87.0
Union, Pa.	77.6
Whitewater, Ind.	74.0
Sandy & Beaver, O.	72.5
West Branch Div., Pa.	66.0
Champlain, N.Y.	66.0

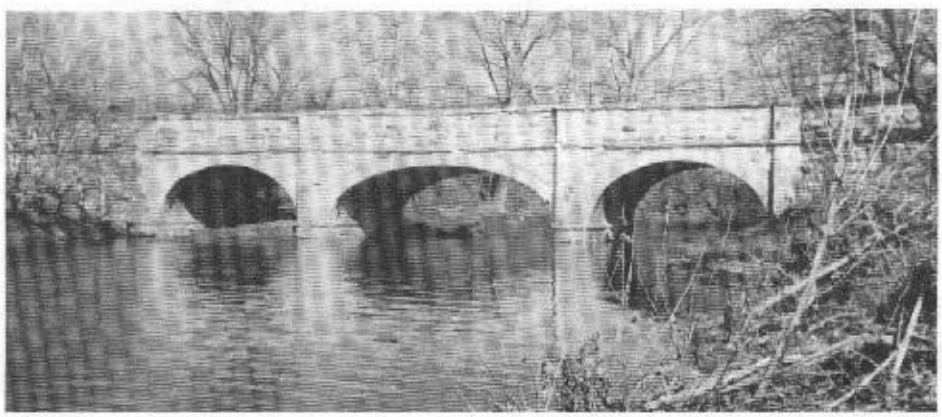
Canal Lift

More important than the mere difference in elevation between canal terminal points is the total rise and fall to be overcome along the canal route. For this reason, the Pennsylvania Main Line Canal from the Susquehanna River west to Pittsburgh represents by far the most difficult job, with a total rise and fall of 3,712 feet. The task was accomplished in canal sections covering 277 miles by 177 locks and a portage railway of 36.7 miles. The next major canal in lift is the Morris Canal which included 23 inclined planes and 23 locks over a distance of 102 miles and a total rise and fall of 1,654 feet.

(Continued on Page Five)

Total Canal Rise and Fall

Canal	Feet - Rise and Fall
Penna. Main Line, Pa.	3712
Morris Canal, N.J.	1654
Ohio & Erie, O.	1206
Black River, N.Y.	1082
Delaware & Hudson, N.Y.	1079
Genesee Valley, N.Y.	1045
Cayuga, N.Y.	1015
Lehigh Nav. Ext., Pa.	935
Miami & Erie, O.	800
Erie Extension, Pa.	738
Erie, N.Y.	676
Sandy & Beaver, O.	669
Chesapeake & Ohio, Md. & D.C.	610
Schuylkill Nav., Pa.	588
Union Canal, Pa.	518
Chemung, N.Y.	518
Wabash & Erie, Ind.	505
Blackstone, Mass. & R.I.	451
Lehigh, Pa.	353



Typical masonry aqueduct on the lower section of the Chesapeake and Ohio Canal, sixth longest canal in the USA. (Photo by Tom Hahn).

Lock Lifts.

To 1851, most canals locks had lifts of ten feet or less. That seemed to be the practical planning limit for most canals. Exceptions where the average lift per lock exceeded 10 feet included the Lehigh Navigation Extension, 32.3 feet per lock; the Alexandria and Georgetown Canal, 16.5 feet per lock; and the Dismal Swamp Canal 12.1 feet per lock.

The most notable achievement in lock construction of the period occurred on the Erie Canal. Near the western terminus of the canal at Lockport, New York, the original canal had to overcome a rise of 60 feet. Nathan S. Roberts devised an artful solution to this problem with tandem locks – those set end to end. He built ten locks in five lifts of 12 feet each having two locks side by side. Each lock was 90 feet long and 15 feet wide. These locks, called the "Lockport Fives", brought canal interests from around the world to gaze at this great exgineering feat.

Lock Sizes.

Inadequate lock dimensions plagued many of the early canals, particularly those that were planned to connect with other canals. Such was the case with the Union Canal's Susquehanna Division, where the locks were built 75 feet long and 8.5 feet wide. This canal was to connect with the Schuylkill Navigation Canal running to Philadelphia; however, when completed in 1827 it was found that its locks were too small to accommodate the boats navigating the Schuylkill. Also, construction had started on the Pennsylvania State Canal (Main Line) on the Susquehanna which might have afforded a Western connection for the Union Canal; however, the Main Line was to have locks 90 feet long and 15 to 17 feet wide. The Union Canal eventually did increase its locks to 90 feet by 17 feet, but the financial strain of expansion almost broke the company.

The largest early locks were the three lower locks on the Patowmack Canal, completed in 1789 which were 100 feet long and 18 feet wide. The Dismal Swamp Canal locks, completed in 1794, were also of this size. The original Erie Canal locks were 90 feet long and 15 feet wide from 1817 to 1826. Then, the Pennsylvania Main Line Canal locks were built two feet wider and, in some places, twice as long, 180 feet, between 1826 and 1834. Taking note of this success, the Erie Canal increased its locks to 110 feet by 18 feet between 1836 and 1862. The largest locks of the period were the 12 locks on the Muskingum Canal, 180 feet long and 36 feet wide, and the three locks at the Louisville and Portland Canal, 198 feet long and 50 feet wide.

Lock Construction

Several early canals of about 1795 had locks made of wood. Most of these hardly lasted through their construction period and were replaced by locks of brick masonry and stone. Domestic deposits of limestone for manufacturing hydraulic cement were first discovered by William Weston, the famous English canal builder, on the Middlesex Canal before 1800. This enabled the construction of sturdy locks of cut stone with hydraulic cement mortar. Later, the same methods were use on the locks on the Erie Canal in 1817 and the major Pennsylvania Canals in the 1820s, whenever limestone deposits could be found within economic hauling distance.

Aqueducts.

The major canals had long aqueducts to carry canals over river crossings and sometimes to maintain constant elevation to take advantage of tributary water feeders so as to avoid serious water supply problems. Examples include the 18 stone aqueducts on the Erie Canal, including one near Schenectady of 748 feet crossing the Mohawk, one of 802 feet crossing the Genesee River, and another 16 miles below Schenectady of 1,188 feet. On the Pennsylvania State Canal, there were 68 aqueducts, including one 1,140 feet long on the Western Division crossing the Allegheny River at Pittsburgh and originally constructed as a wooden trough. On the Delaware and Hudson Canal there were 22 aqueducts, including one crossing the Delaware River at Lackawaxen supported by steel cables constructed by John Roebling in 1847. Today, this aqueduct carries vehicular traffic across the river.

Tunnels.

On several canals, it was found impractical to attempt to overcome a steep summit by a series of locks, and alternative means such as inclined planes and tunnels were adopted. The first tunnel in the United States was constructed on the Schuylkill Navigation Canal, completed in 1825. This tunnel ran through a modest hill above Auburn, Pennsylvania for a length of 450 feet. It was planned to attract attention to the canal venture, and, although it served its purpose it was not at all necessary. A minor change in canal route would have avoided the mountain.

The next tunnel was on the Union Canal just west of Lebanon, completed in 1827. This tunnel was 729 feet long, had a section 18 feet wide and 16 feet high, and avoided an expensive series of locks. The Pennsylvania Main Line Canal had two tunnels in its western division; one was 817 feet long across a bend of the Conemaugh River at Tunnelton and the other, 810 feet long, on the branch to the Monongahela River near Pittsburgh. The longest tunnel was 3,118 feet on the Chesapeake and Ohio Canal near Paw-Paw Bend, built to avoid a long bend on the Potomac River. (See feature story in this issue.)

Inclined Planes.

Inclined planes were substituted for locks on the South Hadley Falls Canal on the Connecticut River in Massachusetts, and on the Morris Canal in New Jersey.

Twenty Steepest Canals

Canal	Length	Number of Locks	Feet/Rise and Fall	Slope/Ft. Mile
Crooked Lake, N. Y.	8.0	27	278	34.8
Black River, N. Y.	35.5	108	1082	30.5
Lehigh Nav. Ext., Pa.	38.0	28	936	24.6
Chemung, N. Y.	23.0	43	516	22.5
Morris, N. J.	102.4	23*	1654	16.2
Hampshire & Hampden, Conn.	22.0	33	298	13.5
Chenango, N. Y.	97.0	116	1015	10.4
Blackstone, Mass. & R.I.	45.0	58	451	10.0
Delaware & Hudson, N. Y.	108.0	110	1073	9.9
Genesee Valley, N. Y.	107.0	104	1045	9.9
Sandy & Beaver, O.	73.5	90	809	9.1
Erie Extension, Pa.	106.0	112	768	7.5
Lehigh, Pa.	48.3	55	353	7.4
Cumberland & Oxford, Me.	20.5	26	143	7.0
Union Canal, Pa.	77.5	95	518	6.7
Schuylkill Nav., Pa.	108.4	120	586	5.4
Susquehanna & Tidewater, Md.	45.0	33	233	5.2
Middlesex, Mass.	28.0	22	136	4.9
Hocking, O.	42.0	26	203	4.8
Santee & Cooper, S. C.	22.0	13	103	4.7

* Also 23 inclined planes

This old print of the Mount Pisgah Inclined Plane on the famous "Switch-Back" Railroad, serving the Lehigh Canal at Mauch Chunk, typifies the many inclined planes in use on the primitive railroads in Pennsylvania before the advent of the steam locomotive.

South Hadley Falls.

In 1793, the first inclined plane was built to permit barges to pass the 53-foot high falls at South Hadley. The plane itself was of rock faced with heavy planks. Barges entered a watertight caisson having folding gates at each end and supported by three sets of wheels of graduated size so that the caisson would remain level. The caisson was then raised up the slope by the power of two water wheels. The plane was later replaced by locks.

Morris Canal.

The Morris Canal had 23 locks and an equal number of inclined planes over its length of 101 miles. Completed in 1831, the planes covered a total rise and fall of 1,334 feet, averaging 58 feet lift each, with the highest being 100 feet. At the end of each plane was a lock connecting with the respective pool. Canal boats were carried over railway by water-powered ropes or cables and lowered (or raised) into the adjacent pool where they were floated from the carriage. The carriage rested on two trucks of two standard railroad-car wheels. By 1845, the planes were modified to take larger boats, so that with the loaded boats the carriage weighed 100 tons. The track was ordinary T-rail set at 18-foot gauge and laid on longitudinal stringers, placed on a foundation wall of masonry. Also, as the canal boats grew in size, some were adapted so that they could be split in two for rail carriage, and then jointed together again by pins for the water journey.

An Engineer officer reported in 1874:

> ...observations made on the operating of a plane at Newark rising 1 foot in 10 feet and having a lift of 70 feet showed that boats were readily and efficiently passed from one pool to the other, over a horizontal distance of about 1,000 feet in four minutes, equal to a rate of twenty-eight miles per hour.

(Continued on Page Six)

CANAL BOOK REVIEW

Facsimile of a 1867 stock certificate issued by the Chesapeake and Delaware Canal Company, sent us by John Trush.

"The Chesapeake and Delaware Canal: Gateway to Paradise"

by Edward J. Ludwig III

Some of the world's most important canals are the shortest. Connecting major rivers, lakes, bays, and seas across narrow fingers of land, their very brevity and convenience have made these compact channels immune to the competition of road and rail. As vital links in the maritime network, they will continue to be of economic and strategic value as long as ships sail the seas.

Less than fifteen miles long, the Chesapeake and Delaware Canal commands importance today as a crucial part of the Atlantic Intercoastal Waterway. When it was first opened in 1829, it fulfilled the dreams of many of the early settlers in the area who had envisioned a shortcut from the Chesapeake Bay to the Delaware River. Built at the beginning of the nation's biggest canal boom, the C & D went on to become one of the most successful artificial waterways in the Middle Atlantic States. Widened and deepened several times, it was purchased by the United States government in 1919 and rebuilt, becoming a sea-level ship canal in 1927 that was deepened and widened again twice thereafter. One of the locks on the original canal can still be seen at Delaware City (no longer the eastern terminus) and the remains of a feeder canal that predate the opening of the first C & D channel are still to be seen near Glasgow, Delaware. Best of all, the Army Corps of Engineers maintains an impressive canal museum at the original lock pumphouse in Chesapeake City, housing the gigantic thirty-seven-foot wooden lift wheel, the largest of its kind, that was used from 1852 to 1927 to supply 130 tons of water per minute to the canal.

Edward Ludwig's brief history and appreciation of the C & D reflects his intimate acquaintance with the canal, its people, and its environs. There is a balanced blend of historical narrative and canal lore, along with guides for the contemporary tourist, that serve well its purpose as a handbook for yachtsman, canal enthusiast, and Delmarva aficionado. Based on reliable secondary sources, local records, and personal interviews, Ludwig's survey gives us a competent history of the canal enhanced by a wealth of otherwise unavailable details, ranging from the servicing of navigation lights to the farmers who collected dead fish from behind the lock gates at Back Creek to use in making fertilizer. The author even notes that the crew on passenger boats compensated for the listing caused by uneven passenger distribution by rolling barrels of water around the lower decks. Ludwig identifies many of the people who worked on the canal, the names of numerous canal craft, and the types of cargo carried through the channel over the years. His account of the salvage of the tanker "F. L. Hayes," which sank and burned in 1952, is particularly striking. Information on the Adams Floating Theater is also noteworthy, and this unusual barge is featured in one of the book's thirteen photographs.

Though his story is accurate, judicious, and well-told, Ludwig's book could have profited from professional editing, not to shorten it but to bring better order to the presentation of material, eliminate a few irrelevant musings and overblown flourishes, and add an occasionally-needed hyphen. Lack of an index makes reference difficult. But none of these shortcomings detracts enough to dismiss the book. In addition to telling the canal's complete history, the value of this short study is enhanced by its attention to recent controversies such as the battle with B. F. Goodrich and the on-going problem with shoreline damage caused by excessive speed in vessels using the canal. Given its price, this staple-bound 56-page book is a true bargain. Copies may be ordered directly from the author at 150 East Main Street, Apt. 213, Elkton, MD 21921. Price of $2.00 includes shipping.

(Reviewed by Ernest H. Schell, ACS, a Ph.D. candidate in American history at Temple University.)

The recently formed Neversink Valley Area Museum, located along the route of the old Delaware and Hudson Canal, is now publishing the "NVAM Newsletter". Information about the Museum, which was recently awarded a federal grant, may be obtained by writing the Director, Charles Thomas, Box 263, Cuddebackville, N. Y. 12729. One of its prime purposes is to inform the public of the historic impact which the D. & H. Canal had upon the area.

CANALS IN EARLY AMERICA

(Continued from page five)

Although the officer had incorrectly computed the speed in miles per hour, covering that distance in four minutes was quite an accomplishment.

Canal Railroad Planes

Inclined planes were also employed effectively on early railroads associated with the canals. Among these were the Philadelphia-Columbia Railroad (two inclined planes); the Allegheny Portage Railroad (ten inclined planes); the famous "Switchback Railroad" at Mauch Chunk, Pennsylvania (two inclined planes); the Ashley Planes, near Wilkes-Barre, Pennsylvania (three inclined planes); and the two railroads serving the Delaware and Hudson Canal in northeast Pennsylvania (total of thirty inclined planes).

THE CANAL BUILDERS

Mention must be made of those who built America's first canals. Among the promoters and investors were such prominent figures as George Washington, William Penn, Ben Franklin, Thomas Jefferson, John Hancock, Patrick Henry, George Mason, and James Madison. There were no trained American civil engineers for the first canals. Fortunately, the great English engineer and canal builder, William Weston, was brought over to advise on the construction of several canals.

The Erie Canal has been considered the first practical school of engineering in this country, and its principal engineer, Benjamin Wright, has been called the father of American engineering. Wright went on to direct and advise the construction of many canals in the United States, including the Farmington, the Blackstone, the Chesapeake and Delaware, the Chesapeake and Ohio, the Delaware and Hudson, the St. Lawrence Ship Canal, and the Welland Canal. Many of his assistants became famous canal builders, including James Geddes, Nathan Roberts, John Jervis, and Canvass White. White went to England to study canal construction and, when he returned to the United States, he was considered to be a genius in canal work.

Other builders of note were James Rumsey on the Patowmack Canal, John Randle on the Chesapeake and Delaware Canal, Josiah White on the Lehigh Navigation Canal, and James Renwick on the Morris Canal.

The early canals played a major role in the economic development of the country and in the training of the first engineers. Without much aid from the Federal government, the States and private companies built over 4,000 miles of canals in the first 75 years of the nation.

It is somewhat ironic that canal construction provided the impetus for the first railroads in the country. By 1851, a number of railroads had been built, several canals found rail competition too great and were abondoned, and the railroads were acquiring interests in many of the remaining canals, which they later phased out of operation. Even so, evidence of the value of early canals remains since the Erie Canal, the Champlain Canal, the Oswego Canal, the Cayuga-Seneca Canal, the Chesapeake and Delaware Canal, and the Dismal Swamp Canal are still operating.

The author, Richard G. Waugh, Jr. is Special Assistant, Board of Engineers for Rivers and Harbors, U.S. Army, Fort Belvoir, Virginia.

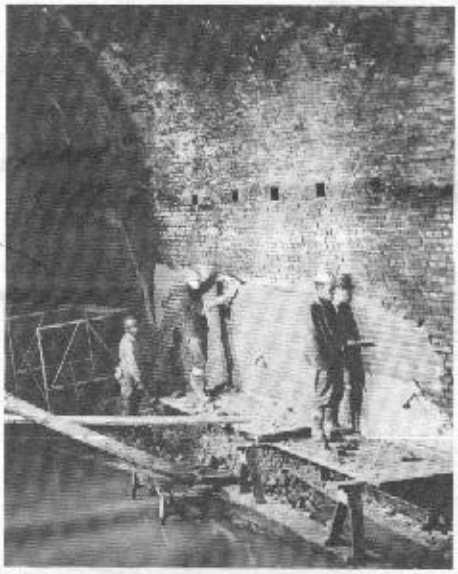
Earl Minderman, of Bethesda, Maryland, has been invited to exhibit his canal paintings at the Great Falls Museum, Rockville, Md., by the National Park Service. His extensive works will be on display (a one-man show) during December and January and will be called "Vistas and Visions – Today and Yesterday on the C. & O. Canal".

PAW-PAW TUNNEL

(Continued from Page Three)

The digging of the tunnel was done by blasting out big pieces of rock with black powder and then reducing them with sledges and picks. Spoil was hauled up the shafts by winches and carted to spoil heaps in the ravines by (probably horse-drawn) rail cars, or else hauled out of the portals by rail to spoil heaps, mostly on the river side of the canal. Those heaps are still visible, particularly above the towpath, downstream of the tunnel.

There are many tales and legends about the tunnel. One involves an Irishman who operated a sort of an elevator at one of the vertical shafts as the tunnel was being dug, bringing loads of rock to the surface and lowering men and supplies, and his mule. The Irishman and his mule shared one characteristic – a very short temper. They quarreled more and more as the work went on, until one day the mule kicked the Irishman where it hurt. Incensed, the Irishman kicked back, only unfortunately, the mule was standing at the edge of the shaft. Down he went, to land angry, but unhurt at the bottom (this is the hard part to swallow as the shafts were 400 feet deep). Only now there was no way to get him to the top again, so the Irishman, in addition to his other duties, had to lower bales of hay and buckets of water down the shaft to the mule until the workers could link up the tunnel coming in from a portal to get him out.



Masons at work on the interior of the tunnel as part of a National Park Service project in the 1960's. (National Parks Service Photo)

At the tunnel entrance the tunnel lining is dressed stone and from then on to 26 feet below the south upstream portal it is brick four courses thick except under the vertical shafts where it is six courses thick. The tunnel has a 12 foot radius set on 11-foot vertical walls. The towpath runs on a ledge about four feet wide and equipped with a stout railing a little better than waist high. The top rail is a square stout beam, in many places showing deep ruts burned into it by tow ropes of mule drawn boats. There are wooden railings or bumpers on both inner sides of the tunnel to keep boats from scraping the brick walls. The height of the tunnel is 24½ feet, and clears 17½ feet above the water. Approximately 82,000 cubic yards of rock was taken out of the tunnel. The greatest depth is forty-four feet, and the tunnel is seventeen feet wide.

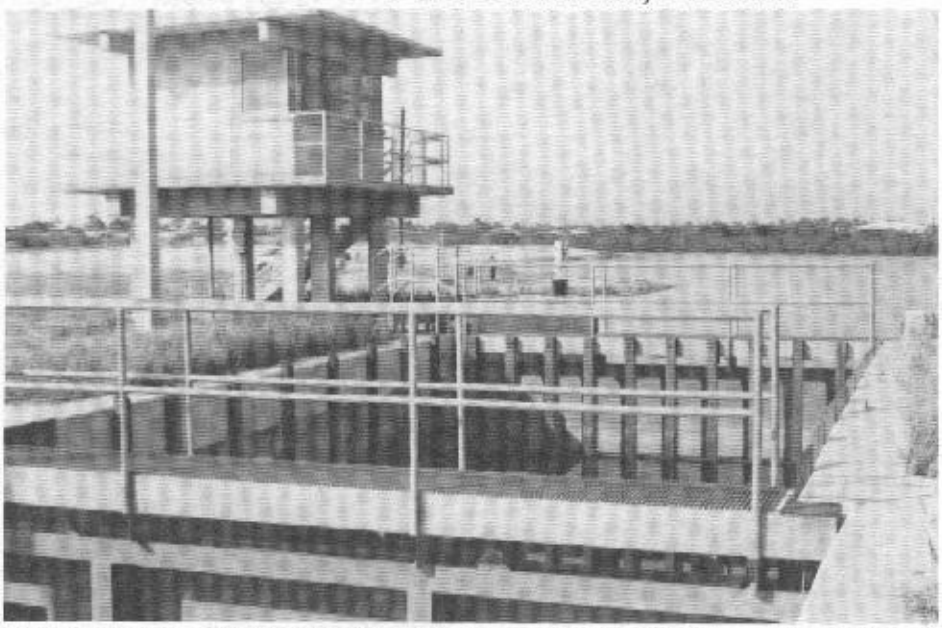
"Weep Holes" were occasionally placed at the spring line of the arch to prevent seepage water from building up and coming directly through brick, an admirable precaution, but one sees that it does not seem entirely effective as a great many patches are visible in the lining. The Park Service did a thorough renovation of the interior of the tunnel in 1966; in 1979 it remains in excellent condition. The two sets of vertical shafts from the surface of the hill overhead are fairly easy to locate by the extensive seepage of water coming through the brick lining from them.

The upstream portal of the Paw Paw Tunnel has stone steps on each side, by which one can climb to the top. Some of the exposed strata (mostly shales) at the top and running down the berm side, contain fossil shells. The engraved keystone is marked "C. B. Fisk, Engineer"; without whose enthusiasm (some say "short-sighted,") the tunnel would most probably have never been built!" He was the canal company engineer who pushed through the tunnel project from the beginning, and who was Chief Engineer when it was finished in 1850.

Bitter arguments would go on when two boats would meet in the middle of the tunnel. A boy was sent ahead to post a lantern at the other end, so that an oncoming boat would know that the tunnel was already occupied and would wait turn. This didn't always work, however, and from time to time canal boats, with their stubborn captains, would meet in the middle. On one memorable occasion, neither side would back down for days. Boats piled up for miles, bets laid and company accountants tore out their hair. Legend has it that finally the section superintendent could stand it no longer, went out to nearby farms and bought all the green corn he could find and then at the upwind end of the tunnel he built a roaring fire as he threw on green cornstalks. With remarkable speed the dispute was settled and the tunnel cleared.

(Tom Hahn, a professional industrial archeologist, is the Editor of **American Canals** and President Emeritus of the American Canal Society.)

New Lock at Port Charlotte, Florida



The new navigation lock at Port Charlotte, Florida, completed in 1978, is approximately 30 feet long and 15 feet wide. (Gould photo)

by Alden Gould

A lock was completed in 1978 for the General Development Corp. Its purpose is to maintain a more or less constant water level in various canals that are adjacent to this area. It appears that tidewater is now prevented from flowing into the upper reaches of these canals once the lock gates are closed.

Previously, normal tides could flow back for several miles inland from Port Charlotte Harbor. Receding tides could cause slight loss of gravel from the canal banks and channel bottom; even this could create low water for navigation, also possible mud flats. However, should an adverse condition occur, such as a tropical storm, then the volume of water involved from high waves and high winds from coastal waters would drive excessive flood waters well inland through these various canals and create damaging floods to property. Once a storm is over and the waters start to recede rapidly, the canals receive their greatest damage due to the speed of the water. Therefore, with the construction of this type of a lock the outflow of water can be regulated by the control tower so as not to drain the canals, but retain plenty of water for navigation.

This lock with a small dam appears to have a high water mark of about 2 feet; that may be normal for this area, although I have not seen a tide table for Port Charlotte Harbor. This new lock has two gates. Both sets of gates **do not** fold back into the chamber wall as we normally see them, but outwardly at the ends of the chamber. Indeed rather unusual! Lock is of concrete construction. Both gates when closed **do not** form a VEE, but extend straight **across** the ends of the chamber walls. Gates are gear driven by motors and are completely controlled electrically from a panel board having a series of push buttons. Also automatically controlled are the traffic lights, which operate at a given period if lockage is safe to proceed from either direction. Directions are posted for individual operation, or, this may be handled by the Lockmaster from the control tower if he is on duty. However, this is an ideal locking system and very well suited for the area involved. The chamber appears to be approximately 30 ft. long, approximately 15 plus wide. Chamber walls appear to be about 5-6 ft. above water level in chamber.

This lock and the canals in the area are used by small craft which operate on these navigable waterways, which in turn pass through residential areas where estates are palatial and have their private piers along these several canals and waterways. In general, the canals are quite wide **except** when passing under highway bridges. Some of these navigable canals are several miles long and form a link to connect with Port Charlotte Harbor.

Access to this area from Fort Myers, Florida is as follows: Take U.S. #41 north to Punta Gorda, cross the Peace River there, then follow into Port Charlotte (watch for Midway Blvd.) on **left,** make this left turn and follow several miles until you come to O'Hara St. then **sharp left** where you will then see the control tower and parklot.

CANAL BUFFS TOUR WELLAND CANALS

Part of the Welland Canal Tour group gathered in the Port Weller Dry Docks, near St. Catharines. A complete tour of the dry-dock facilities concluded our Saturday afternoon activities.

by Joy Aschenbach
National Geographic News Service

ST. CATHARINES, Ontario (Sept. 14-16, 1979) – Richard Cavagnaro grew up near one. Keith Kroon bought a house on an abandoned one. William Shank heard a speech about one. Thomas Hahn took a walk along one. Others stumbled upon them through their love for steamboats and trains.

Where some people see "a ditch," these people see old canals – a forgotten era of transportation to be unearthed, studied, saved, restored, and enjoyed.

Too many canals, they say, have been fouled with debris, overgrown with weeds, neglected, polluted, plowed under, and built over into highways and parking lots. Before the railroads, there were more than 4,000 miles of canals in the United States. Today, they point out, there are only about 2,000 miles, many abandoned.

Canal lovers have formed or joined various canal societies, spending weekends, vacations, and spare time hunting for the bits and pieces of what's left.

"I've been wandering around old canals off and on since I was old enough to drive," recalled 58-year-old Cavagnaro, a member of three canal groups, who lives in Lockport, N.Y., on the Erie Canal and has traveled from Massachusetts to Virginia looking for old locks and channels.

On the Sept. 14-16 weekend over 100 American Canal Society and Detroit Marine Historical Society members boarded buses in St. Catharines for a field trip through Canada's 150-year-old Welland Canal, the only navigable link between Lakes Ontario and Erie around Niagara Falls. They set off with cameras, notebooks, maps, pages of background material, and a geography professor from a nearby university for one of the guides.

They wore canal T-shirts, like the beige ones imprinted with a brown map of the Ohio canals, or canal jackets, like the blue and gold ones outlining the Pennsylvania canals, or the red, white, and blue canal boat badges of the American Canal Society, the only national canal organization in the country.

The Welland offered them four generations of man-made waterways. It has been rebuilt and rerouted four times since 1829, enables ships to overcome the 326-foot difference in level between the two lakes, and is now part of the St. Lawrence Seaway.

"What you have to imagine here is that it's the end of winter in the 1850s and some 200 schooners are waiting for the canal to open for the season," Dr. John N. Jackson of Brock University said as he stood at Lake Ontario's Port Dalhousie, where the old Welland and the canal society tour began.

As the canal people hopped on and off buses all day, Jackson traced the history, engineering, commerce, and life along the various routes of the Welland – pointing out whatever parts of the old remain.

There was a stone lock with its iron gate hinge that now leads straight into a gas station, a lockkeeper's cottage, the stone support of what was once a whole line of mills, a half-buried canal boat, a dry lock overgrown with yellow and lavender wildflowers, a waterfall on what was once a narrow stair-step set of locks, and the number still carved in the stone wall of Lock 18 of the old Welland.

At a point where the current canal still follows the route of the original channel, the group witnessed a reenactment of the turning of the first spade of earth for the Welland. In observance of the canal's 150th anniversary, a local actor, bearded and dressed in top hat and 19th century garb, portrayed William Hamilton Merritt, the Canadian businessman who is credited with building the Welland.

At a slide lecture they heard Dr. Robert Taylor, a Brock history professor, relate the familiar story of people not appreciating what's in their own back yards. "The lands along the old canals are treasures that the Niagara region has neglected," he said. "They are a bit desolate. Many remains actually had to be hunted for."

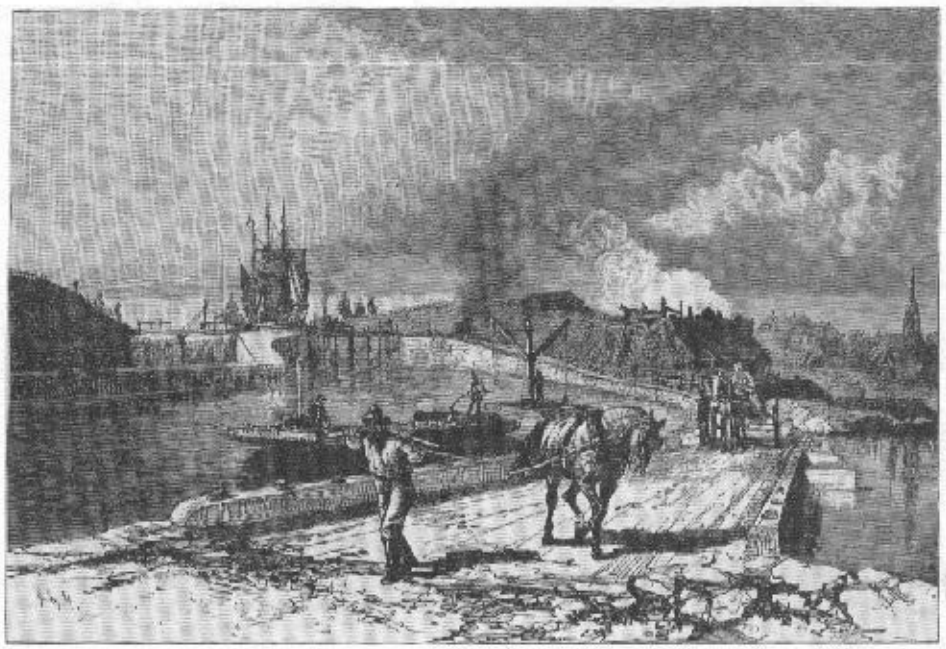
The Welland Canals Preservation Association was formed just two years ago at a meeting in a university classroom, he told them. It hopes to create a park – with bicycle trails, picnic tables, swimming, boating, and skating – along the canals.

Canal weekends, like the one at the Welland, enable canal group members to trade canal stories and information and to call attention to the old waterways before, they said, "we reach the point where we're down to one lock left."

"Canals are a way of life that is almost gone. The men who worked on them are gone and . . . most people have forgotten that there was something in this country before the railroads," American Canal Society President William Shank, of York, Pa., said.

"Until 20 years ago, when I heard a lecture about them, I did not know that there were 1,200 miles of canals running all over Pennsylvania. I was fascinated, and hooked on canals right then."

The Canal Museum at Syracuse, N.Y. has been awarded a grant of $30,000 by the federal Heritage, Conservation and Recreation Service to mount an intensive underwater survey of nineteenth century Erie Canal boat remains. The search will cover not only the line of the abandoned Erie Canal but the Finger Lakes region where canal boats once journeyed to pick up cargo.



"A Lock on the Old Canal, Thorold. From "Picturesque Canada" . . . 1882". This illustration is part of a flier issued by Brock University in St. Catharines featuring the Proceedings of the First Annual Niagara Peninsula History Conference, 21-22 April 1979. ($5, Can., Acquisitions Department, Brock University Library, St. Catharines, Ont., Canada, L2S 3A1.)