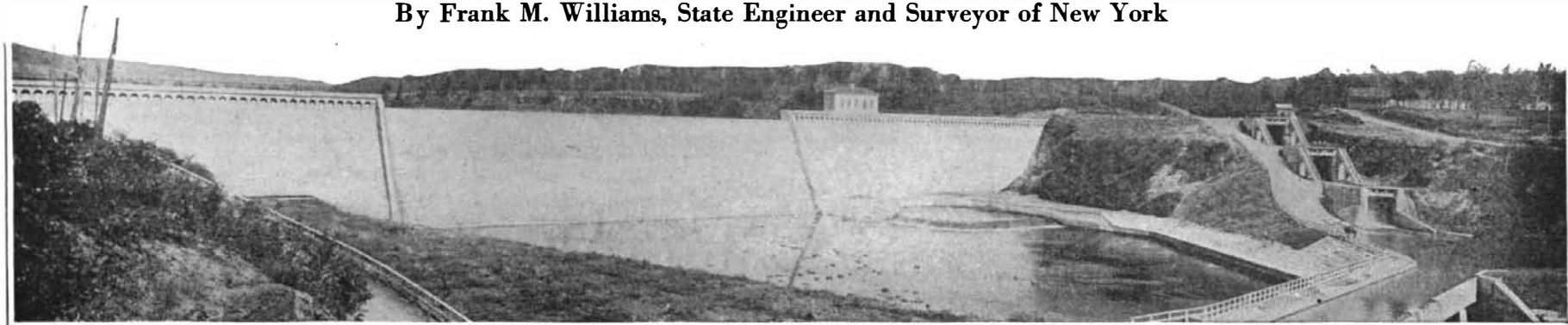


The New York State Barge Canal—II

Some Details of the Engineering Problems and the Way They Were Met

By Frank M. Williams, State Engineer and Surveyor of New York



The Delta Dam which impounds 2,750,000,000 cubic feet of water in a natural basin in which once stood the village of Delta. The reservoir covers $4\frac{1}{2}$ square miles and is one of several such structures along the canal

ONE of the greatest problems involved in the construction of the Barge Canal was that of obtaining sufficient water to provide for the minimum depth at all times. That portion of the Erie branch extending eastward to Three River Point is mainly supplied by water from the Niagara River, supplemented by additional supplies from the Finger Lakes tributary to the Seneca River. The summit level at Rome is supplied from two existing reservoirs, as well as several stream diversions south of the Erie Canal between Syracuse and Rome and from two storage reservoirs located on the Mohawk River at Delta and on West Canada Creek at Hinckley. Water from the latter reservoir is carried down West Canada Creek for a few miles and then by a new open channel across a divide into Nine Mile Creek, a tributary of the Rome summit level.

The storage reservoir at Delta was formed by building a concrete dam about 1,000 feet long across the valley of the Mohawk River. This dam has a maximum height of 100 feet, floods an area of $4\frac{1}{2}$ square miles and provides for the storage of 2,750,000,000 cubic feet of water, which is impounded in a natural basin where the village of Delta was once located. The Hinckley Reservoir consists of an earthen embankment covering a masonry core wall and is formed by a dam 3,700 feet long. It floods an area of $4\frac{1}{2}$ square miles and has a storage capacity of 3,445,000,000 cubic feet of water.

The summit level of the Champlain Canal at Fort Edward is supplied from an existing feeder

taking water from the Hudson River at Glens Falls. A portion of the water supply to the summit level passes northward to Lake Champlain, and the remainder southward to a point where the Hudson River has been canalized. The Cayuga-Seneca branch is fed entirely from the two lakes from which its name is derived, while the Oswego follows the Oswego River which has sufficient water for canal purposes.

In constructing the waterway about 100,000,000 cubic yards of material had to be excavated, approximately 10 per cent of this being rock. This work called for the use of a great variety of machinery and demanded some highly perfected types of excavators and dredges. About 3,000,000 cubic yards of concrete was placed.

The Locks

There are fifty-seven locks in the Barge Canal. These all have inside rectangular dimensions of 45 by 310 feet, the usable length of each being at least 300 feet and the usable width 44.4 feet. All of these structures are built of concrete, the side walls being from 5 to 7 feet wide at the top and varying in height and bottom width with the lift of the lock and other conditions. In some cases, where one side of the lock

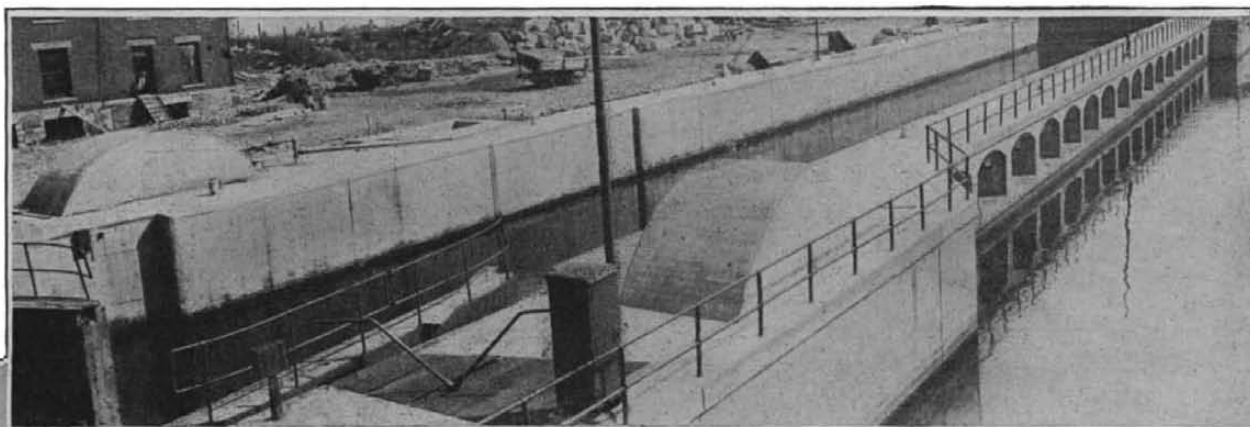
is exposed to a river channel the top width has been increased to 12 feet. The bottom width of the walls ranges from 13 to 34 feet and is determined by the height of the walls, nature of the foundation, and certain incidentals in design.

The chambers are filled and emptied through ports connecting with conduits extending lengthwise through the locks side walls. The flow is generally controlled by vertical lift valves, the exception being at Oswego where the chamber is filled and emptied by siphons.

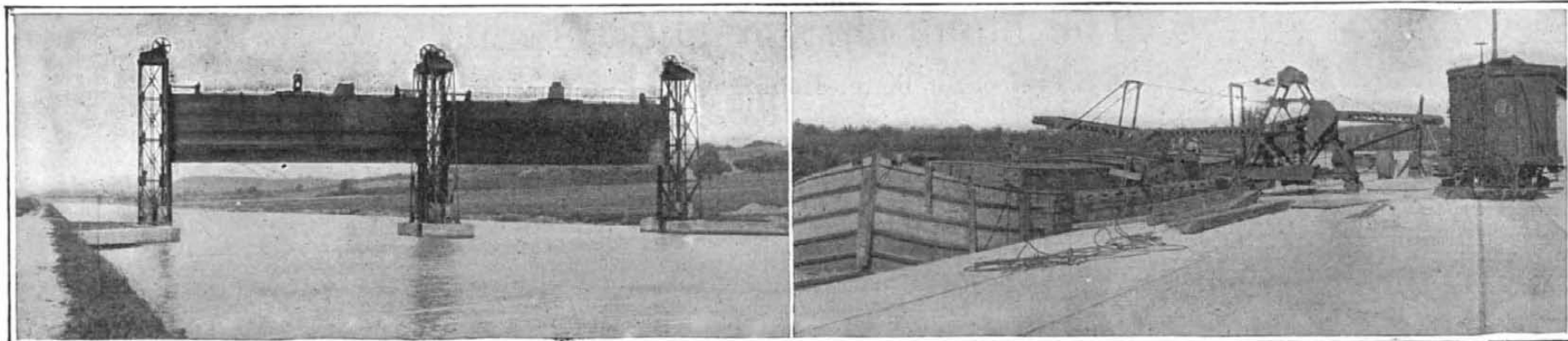
Nearly all lock gates are constructed of steel and are of the mitring, girder type, the exception to this latter being the lower gate of the lock at Little Falls, which is of the solid lift type similar to the type employed as guard gates. In all cases, however, the minimum depth of water over the miter sills is 12 feet.

All locks are operated and lighted by electricity. Most of the locks have been provided with hydraulic turbines and the electricity used in operating and lighting is generated at the lock. In some localities power plants have been built which furnish electricity to several locks within a radius of a few miles while, in the Mohawk Valley the locks and movable dams are operated by electricity generated by gasoline motor sets, water power not being available.

The largest lock on the canal is at Little Falls and this structure has a lift of $40\frac{1}{2}$ feet being one of the highest locks in the world. The most interesting locks are the five massive structures comprising the Waterford Series at the eastern terminus of the Erie Canal. These have a



Left: Handsome highway bridge over the canalized Mohawk river at Amsterdam. Right: Guard gates at the head of Waterford locks, where they lead into Lake Crescent.
Top: Siphon Lock at Oswego, with a lift of 25 feet. The largest siphon lock in existence and the first to be built in the United States



Left: Guard gates like these are located every ten miles in the land line sections. If a break occurs in the banks, the gates are dropped on each side of it. The water in the 10-mile stretch is diverted to by-passes, and repairs can be made. **Right:** Portable package freight conveyor, installed on the Schenectady Barge Canal Terminal for transfer of package freight

combined lift of 169 feet and constitute the world's greatest series of high lift locks. Another interesting and unique lock is located at Oswego. This structure has a lift of 25 feet and utilizes the siphon principle in its operation, being the largest lock of its kind ever constructed and the first to be built in this country.

The Dams

For fixed dams a gravity type either straight or curved, with a rounded downstream face, has been used. The height of these dams varies from 6 feet at the Coughdenoy dam on the Oneida River to 100 feet for the reservoir dam at Delta.

Movable dams have been used wherever necessary to reduce damage from floods and ten of these structures are located between Schenectady and Utica in the Mohawk River. Several general types of movable dams are used, the principal one being the bridge type and another being made up of Taintor gates. The Taintor gates when in use rest upon a sill crossing the bed of the stream and are opened

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Tabloid History of American Merchant Marine

IN a special study made by the United States Shipping Board, it was found that 293 steamers under the American flag left American ports during the month of June, carrying a total of 1,177,444 tons of exports. Of this number 243 steamed from Atlantic ports, 33 from Gulf ports and 17 from Pacific ports. The value of the exports carried by these vessels in the one month was \$268,228,502, or more than 50 per cent greater than in the entire year 1914, when the total value of American exports carried in American bottoms was only \$166,055,081.

The Shipping Board drew attention to the fact that the percentage of American shipments carried in foreign vessels in 1914 was 91.8% of the entire export trade for that year. This compares with 66.9% for the month of June of this year, when \$540,424,846 in exports were carried in ships flying foreign flags. Even as recently as 1917, more than 85% of our foreign going commerce was carried in foreign owned vessels. The gain in two years, from only 14.6% in 1917 to 33.1% in 1919, is the most striking evidence of the power of the new American Merchant Marine.

The diagram traces the percentage of exports carried in American bottoms over a period of about 90 years, beginning with 1830, at which time our own ships were taking care of more than 85% of our exports. With the exception of one point on the curve, that for 1860, a steady decline is shown in the percentage carried in American ships, from 1830 until the close of the last century. The partial recovery from that date until 1914, when the great war tie-up of ships forced us to depend more upon our own resources, was so slight that the present movement along the line of heavier use of American ships is all the more gratifying.

As the program of the Shipping Board progresses further and further towards final completion, and the ships available for American commerce increase to a much greater volume than those at present in use, we may confidently expect to

see the percentage of American exports carried in American ships increase with the fleet of ships, until it reaches what may be considered a normal ratio of about half our total export trade.

The foreign-going steam merchant fleet of the United States on June 30, 1914, was about 43% of the world's tonnage of vessels of 1,600 tons and over. At the end of 1918 our percentage had gone up to 16.5, or ap-

proximately one-sixth the total. The tonnage actually under construction in the United States in 1918 was half that of the entire world; and the latest Lloyd's report shows about the same situation, with British construction less than two-thirds as heavy as ours. It seems fair to assume that by the end of the current year American foreign-going tonnage will be close to 30 per cent of the total world's tonnage, for the Shipping Board announced, in mid-September, that

the steamships under the American flag now comprise 24.8 per cent of the world's steam tonnage, and that 1,107 of the 1,280 vessels had been built by the Board within the last two years. With this as a basis, it ought to be relatively simple, barring congressional handicaps, to maintain our own position in the commercial field, and carry at least half of our own products as well as half the products shipped to us from foreign lands.—*Sidney Graves Koon, M.M.E.*

A Day's Telephone Calls

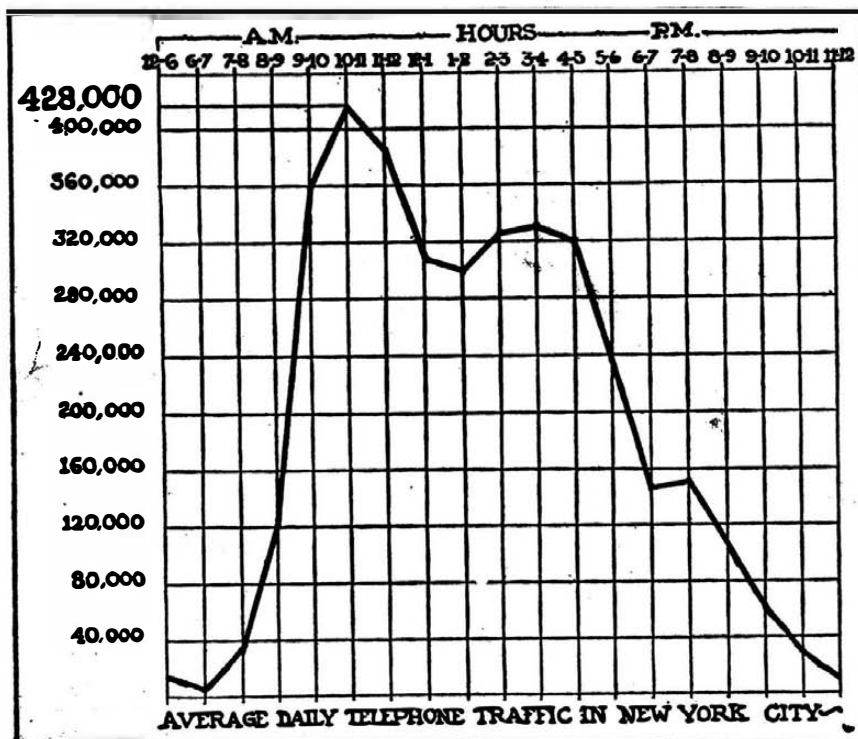
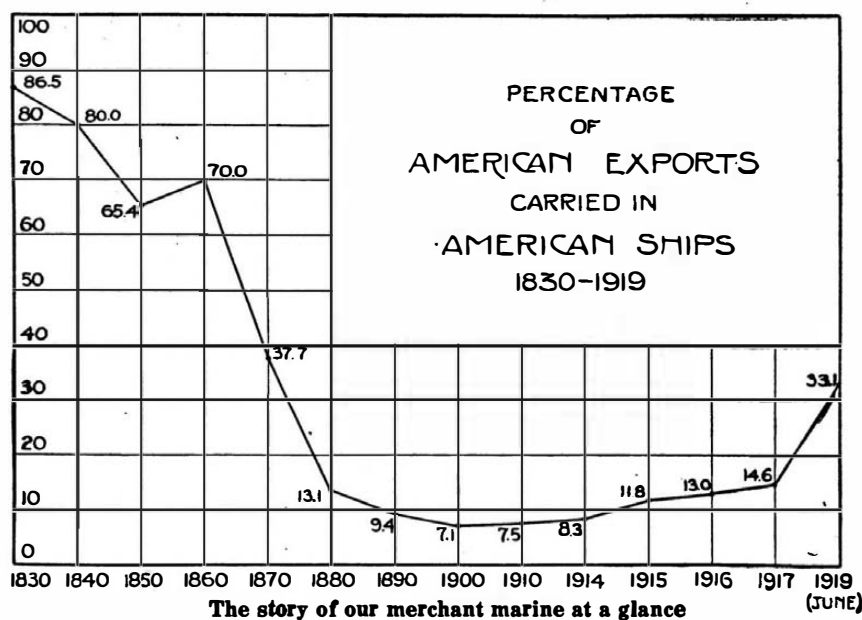
WHEN do you use the telephone most often? At what hour does the report "Busy" come back with the greatest persistence? What are the times of day at which you have to wait longest for a connection—presumably because all the trunk lines out of your central office are for the moment carrying a full load? The answer to these questions is carried on the chart herewith, prepared by the New York Telephone Company as a suggestion to its subscribers for their coöperation in the improvement of the service.

This chart represents the telephone business of the average day. From midnight to 6 A. M. it is small and getting smaller; then as the retail stores and other "early" businesses begin to shake off their slumbers it starts to mount. As offices open and clear for the day's action the rate of increase gets faster and faster, until in the one hour between 9 and 10 the calls are three times as numerous

as during the 60 minutes immediately preceding. As the day's business gets into full swing, with everybody at work, calls continue to increase, though at a much less alarming pace; and the peak-load for the day is carried by the hour between 10 and 11, with 428,000 calls in the city. After 11 o'clock it appears that the impending lunch hour makes a certain number of telephone users feel that what calls they still have to make will best go over until afternoon; and from 12 to 2, while the city is eating, there is a still further drop—though 300,000 calls per hour during lunch time is a pretty respectable total after all.

When we return from our mid-day meal we do not run the wire business up to such a sharp peak as we did in the morning, when the urgent calls of the day were being made. The afternoon load is fairly constant from 2 to 5. Then it falls rapidly, however, and with the exception of the hour from 7 to 8, when people call up their friends to arrange for the evening's entertainment, there is a steady and rapid decline to the irreducible minimum of the next daybreak.

Individual days of course show peculiarities, which it is the business of one division of the company's engineering department to account for. When a single transportation line breaks down late in the afternoon there is frequently a peak rivaling that of 11 A. M., caused by the desperate efforts of all Staten Island or Flatbush or the Bronx to inform its family that it will not be home to dinner, and why. When the fake armistice story broke upon New York in November, 1918, just as the morning peak-load was being passed, everybody who could get access to an instrument tried to telephone home that the war was over, and the wires were literally swamped.



The course of New York's telephone traffic for 24 hours

knots, while S-3 can cover 10,000 miles at 11 knots. The submerged cruising radius shows an equal preponderance in favor of S-3. Both boats can carry twelve torpedoes. U-111 mounts two 4-inch guns, one forward and one aft, while S-3 mounts one 4-inch forward, this practice of one gun on a submarine being standard practice in the United States Navy.

Much has been written of the seaworthiness of the German submarine. An opportunity to compare the seagoing capabilities of the two vessels occurred during these trials, and the general consensus of opinion among the officers conducting the test is that S-3 is the more seaworthy vessel. Her decks are drier, her bridge less subject to green seas, and her general behavior in a seaway superior. Referring to the comparative diving capabilities of the two vessels and general handling, there are few differences, and these few appear to favor the S-3.

New York State Barge Canal

(Continued from page 41)

by raising them from the sill by machinery or by hand. The largest Taintor gates in the world are located on the Champlain branch of the canal.

The bridge type of dam consists of a heavy steel structure very closely resembling a bridge in appearance. The spans vary from 150 to 240 feet between piers while a concrete sill extends across the bed of the river. Steel uprights are attached to the downstream chord of the bridge and when in position for use their lower ends rest against heavy castings set in the concrete sill. Steel gates are placed in tiers against the upstream side of adjacent uprights forming a dam. The water is maintained at the proper height above the dam by varying the number of gates used, in periods of low water all or nearly all of the openings are closed while as the stream rises above its normal level because of rains, the gates are removed from time to time to maintain the pool level at the proper height. In the event of a heavy flood and during the closed season on the canal all the gates as well as their supporting uprights are raised and attached to the bridge floor, leaving the flow of the stream unobstructed. The gates are raised or lowered by means of electrical winches running on the bridge floor of the dam. Only two automatic dams have been constructed on the canal.

Spillways

To reduce the fluctuation on certain levels of the canal, spillways have been built, so that as the water rises above the normal level it will pass over the spillway and into adjacent streams. At several locations a type of spillway known as the siphon spillway has been used. When the water rises above a certain point it begins to pass, at first slowly and then rapidly, through the siphons. This flow continues until the water has receded to a certain level when air enters the siphons and their action ceases.

By the use of this type of spillway it has been found possible to obtain the same regulation on a spillway 57 feet long as with one without siphons 200 feet in length.

Bridges

Several hundred new bridges have been built over the canals, the law providing that they should have an under clearance of at least 15½ feet when the water in the channel is at its maximum navigation stage. The greater number of these new bridges are of the fixed type; but a few towns and villages have been provided with vertical or bascule bridges. This was due to local conditions, and when closed the bridge forms a portion of the roadway, and when raised or opened gives the necessary clearance for the passage of barges.

Guard Gates

A type of structure which is very necessary as well as striking in appearance, is the guard gate. These have been placed at intervals of about 10 miles on all land lines, the intention being, that in the event of a break in the embankment or damage to a structure, that portion injured can be isolated by closing the nearest gates in each direction. This will tend to reduce the damage done to property by flood and will make it easier to repair any injury to an embankment or structure. Guard gates are also located at points where the land line joins the canalized rivers and lakes.

Terminals

In order that the Barge Canal may be of the greatest benefit it is necessary that harbors and terminals should be provided at various points where freight may be readily loaded or unloaded. It would be illogical to build a railroad across a country without making provision for passenger stations, freight yards and freight houses and it would, likewise, be illogical to construct a modern waterway without proper terminal facilities. Having this fact in mind the people of the State of New York, by popular vote provided funds for the construction of terminals along the Barge Canal. The plans for the terminals vary with the needs of the district served, but in general they consist of suitable docks, mechanical devices for the handling of freight quickly and cheaply, and buildings for the temporary storage of freight, while, in many cases, connections have been made with adjacent railroads.

The purpose of the state was to furnish places where any shipper can have the advantages of efficient terminal facilities at a reasonable cost. Funds have been provided for terminals at all the cities and many of the smaller towns and villages along the route of the Barge Canal. The majority of these have already been constructed while some equipment has been placed on many of them.

The mechanical equipment of the terminals and their general arrangement as to docks, buildings, railroad connections, etc., follow generally that in use in foreign countries in accordance with the report of a Barge Canal Terminal Commission which, in 1910, visited various European countries and reported on the types of terminal machinery used.

The Barge Canal is an extensive undertaking. It has been constructed at an expenditure, including terminals, of a little more than \$150,000,000 and is now available. In constructing it every effort has been made to give the State of New York a thoroughly modern and up-to-date waterway connecting the Great Lakes with the Atlantic seaboard. Two years' operation of the completed system have demonstrated the truth that the waterway is a structural success. It is in a position, however, similar to that of a railroad system without locomotives or freight cars, and what is needed to make the Barge Canal a commercial and economic success is boats, boats and more boats, so that it can carry its maximum capacity. This can be made as high as approximately 20,000,000 tons of freight per year.

(Continued in a later issue)

The Shunt-less Freight Terminal

(Continued from page 42)

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