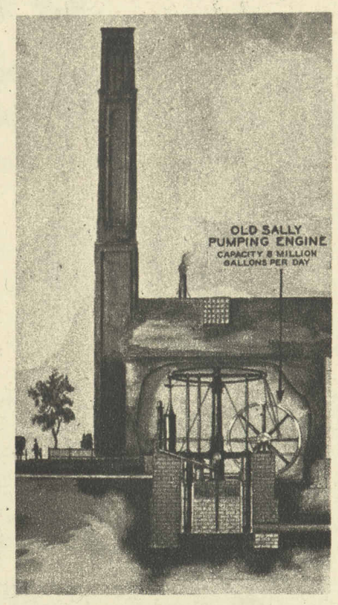
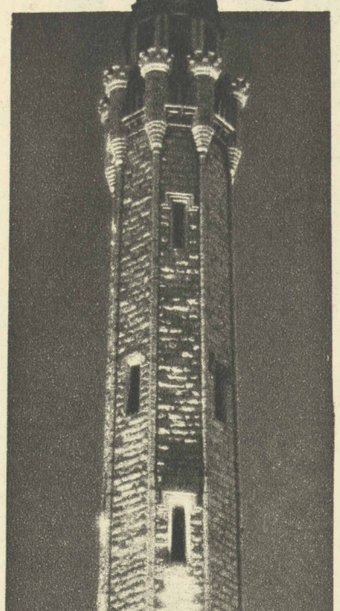
The Drama of Chicago's Water System

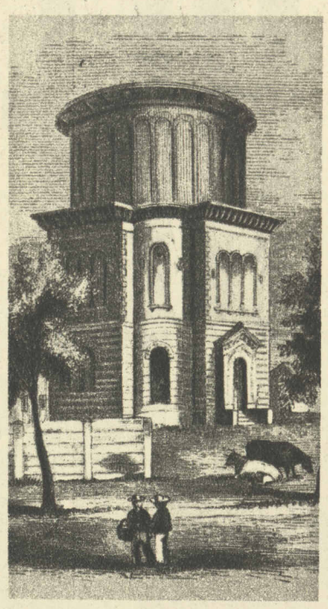
Pumping station and tower in 1854, after new system had been installed following political battle over city's acquisition of water system.



Diagrammatic drawing of "Sally," mechanical marvel of its day.



The water tower.



Adams street reservoir during the fifties. It held three days' supply.

Laying the corner stone of the present water tower on March 25, 1867. The new water system was put into service later that same year.

Quenching a City's Thirst Made Engineering History

(Continued from page one.)

engine which could raise 25 barrels of water a minute into a reservoir 35 feet above the lake level.

This reservoir was built of wood at the corner of Lake street and Michigan avenue, and it was big enough to hold 1,250 barrels. Out of it the water flowed by gravity through wooden mains to the part of the young city that is now the loop.

In 1851 an issue was made on the question of public ownership of the water system. Walter S. Gurnee was elected mayor and the rights and franchises of the Chicago Hydraulic company were taken over by the city.

Naturally the primitive wooden water system, which was continually getting clogged up with fish and other unwanted matter, was no longer considered adequate, and an engineer from New York named McAlpine was summoned, with the result that in 1854 an entirely new system was put into operation on the site of the present old water tower on Chicago avenue.

A building and standpipe were erected, within which was installed a great vertical beam engine that was a wonder in its day. Its cylinder was 44 inches in diameter and its piston stroke was 9 feet. The great flywheel had a diameter of 24 feet and weighed 12 tons. The "walking beam" was 30 feet long.

For half a century, until 1903, this venerable piece of machinery continued in service and attracted many sightseers and visitors. It was affectionately known to the engineers as "Sally." The water intake was a timber crib about 600 feet offshore surrounded by a basin a thousand feet across formed by breakwaters of rough stone blocks through which the water had to percolate into the basin.

After being raised by the pumping engine the water was distributed to three reservoirs—one at Chicago avenue and Sedgwick street, one at La Salle and Adams streets, and the third at Monroe and Morgan streets. Each of these reservoirs held two or three days' supply and supplied a large section of the city through iron water mains.

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This new water system, wonderful though it seemed at first, could not long be sufficient to a city growing at the record pace of early Chicago. During the first four months the pump operated but nine hours a day and not at all on Sundays except in case of fire. After that it was given longer hours, but a second and more powerful pump had to be installed and started working in 1857.

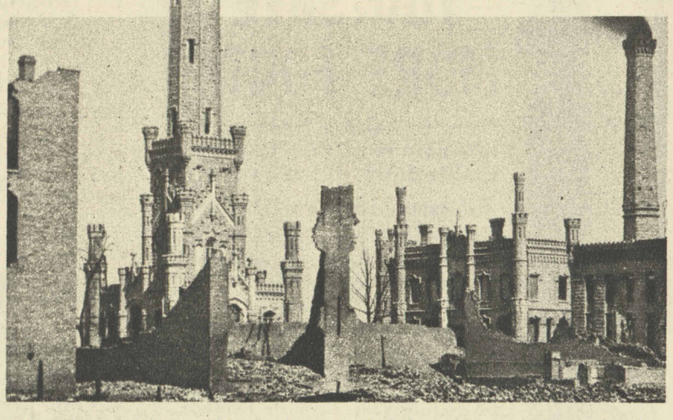
Then more trouble came. The increasing amounts of sewage and packing plant wastes dumped into the river were resulting in widespread pollution of the lake. The growing prevalence of typhoid fever, diarrhea, and other water-borne diseases in the city became alarming. Obviously the intake must be moved farther out in the lake. And also obviously a bigger pumping station and distribution system must be provided to keep step with the population.

Accordingly a board of public works was created on May 6, 1861, and Chief Engineer Ellis S. Chesbrough was entrusted with the job of planning for the future. The Chesbrough plan, adopted two years later, embraced the bold idea of building a tunnel under the lake to an intake two miles offshore at Chicago avenue, with a new and bigger pumping station and water tower. The completion of this ambitious project in 1867 marked the beginning of the Chicago waterworks of today.

The earlier water tower, built to hold the water high enough so that it would flow to the various reservoirs, was of brick, fourteen feet square at the bottom and tapering slightly to its top, 136 feet above the ground. The new water tower, which is the one that still stands at the corner of Michigan and Chicago avenues, reached a height of 150 feet. A report in 1868 spoke of the new buildings as follows:

"Chicago has outgrown her waterworks of sixteen years ago. Today upon the site of the old buildings stand in their stead white stone structures which for beauty, strength, and magnitude are probably unsurpassed by any buildings in the United States for like purposes."

But, of course, the most remarkable feature of the Chesbrough water system was not the handsome water tower, but the hidden tunnel which brought an unlimited supply of pure water to the city from the ample distance of two miles offshore.



After the great fire. Chicago has adopted the water tower as a symbol of the spirit which developed the city and rebuilt it after the disaster.

This first water tunnel in Chicago was a daring engineering project, and its success brought international fame to Engineer Chesbrough. The story of its building, which was to be repeated scores of times in later years as more tunnels were copied from its principle in Chicago and other lake cities, is an epic of the modern world.

After the somewhat skeptical legislators had finally passed the necessary ordinances for the project, work was begun on the land end of the tunnel on March 17, 1864. A vertical shaft was dug nine feet in diameter and sixty-six feet deep, and from there the tunnelers turned eastward, digging horizontally out under the lake and building as they went a tube of brick and concrete five feet in internal diameter, laid sixty feet below the water level.

As the tunnel was being dug outward from shore, construction work was also going ahead on a massive five-sided intake crib 40 feet high and 58 feet on a side. It consisted of two timber walls of similar pentagonal shape, the outer one being separated from the inner one by a gap of 25 feet, and the five sides of the outer exactly parallel to the five sides of the inner, the space between to be filled with a compact body of masonry after the crib was placed in position. The engineer's report further describes it:

"Three rectangular openings, each 4 feet wide and 5 feet high, were made through the sides so that water could be drawn . . . as might be required. Each of these openings was provided with gates. . . . The hollow walls were made water-tight and a bottom of planking provided, so that when launched the crib would float, which it did accordingly."

It took more than a year to build this massive brain child of Chesbrough's, and naturally there was great public interest on the day it was launched and towed two miles out to its appointed position and there sunk into place preparatory to being filled up between its walls with stone.

The water was thirty feet deep at this point, and so the crib walls rose ten feet above the surface, forming an effective breakwater against the waves once the walls were filled. But unfortunately a very violent storm arose on the lake before the workmen had time to fill the crib more than a quarter of the way up, and the scows carrying stone to it had to abandon work until the storm subsided. This happened only after three days of tremendous waves, during which time it was feared the crib might be totally destroyed.

Luckily it was not, however, and the builders were overjoyed to find it whole after the storm and only thirteen feet out of position and slightly tilted.

"There would have been great difficulty in restoring the crib to its exact position," said the engineer's report, "and the fear there might be another storm meantime prevented any attempt being made. The very slight deflection this rendered necessary in the line of the tunnel was of no practical importance whatever, though regretted, and the variations of the sides of the crib from perpendicular . . . did not affect its stability.

"The filling of the crib was proceeded with as fast as the contractors could, and since it was completed, about the middle of August, 1865, no variation whatever in the position of this structure has been perceived."

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Once the space between the crib's outer and inner walls was filled with stone, a huge iron cylinder of nine-foot diameter, and open on the ends, was sunk within it, reaching from the lake's floor to the surface. This great tube was then pumped dry and a crew of men began digging downward from inside it until, on reaching the sixty-foot-below-water level, they continued in a horizontal direction toward the tunnel approaching from the shore.

"The daily average of progress was nine and one-third feet, and, having reached a point 2,290 feet from the crib, the two digging parties met. The two faces were brought together on Nov. 30, 1866, when it was found that the masonry at the east face was only about 7½ inches out of the line from the west end."

The enthusiasm of the public over the tunnel's completion was extraordinary. A flag was raised on the courthouse tower, and Mayor Rice and members of the council toured through the tunnel on a train of dump cars pulled by a mule. Later a banquet was served in the crib's kitchen, accompanied by cannon booming salutes both from the crib and the shore, this followed by speeches by the mayor, Chesbrough, and other celebrities. The tunnel was officially dedicated and started functioning with the pump on March 25, 1867. Two years later, in 1869, the new north pumping station (now the Chicago avenue pumping station) was completed and added to the system.

The next improvement in waterworks came after the great Chicago fire of 1871, which clearly proved the need for a better balanced water supply for fire protection in the city. There was an increasing demand for more water on the west side, and when a water main burst where it crossed the river the board of water commissioners decided to build a new tunnel and pumping station to serve the west side. Accordingly in 1874 a second tunnel was dug, parallel to the first and only fifty feet from it—but this tunnel was bigger, being seven feet in diameter, and it continued a long distance west under the city's streets and buildings to a new pumping station at 22d street and Ashland avnue.

Up to this time the tunnel contractors and engineers had been lucky. But as new and bigger tunnels and new cribs were built, many heartrending difficulties arose. Water-bearing sand and silt forced changes of direction of the third tunnel, and even abandonment of much work that had been completed. This tube, from the present Harrison street pumping station to a crib off Roosevelt road known as the four-mile crib, was eventually put into operation in 1892, but it had proved to be "continuous grief," in the words of a contemporary engineer.

Quicksand and "swelling" clay which confronted the tunnelers forced them, at large expense, to abandon their original intention of making an 8-foot tunnel and to substitute for it two 6-foot tunnels. Records of those days fail to mention how many workers lost their lives—but the number must have been large. The crib itself caused long delay. First, as the great steel shells, 54 feet high and 75 feet in external diameter, were being transferred from the shore to a scow, they fell into the lake and had to be taken apart again. Later sudden storms wrecked the crib's foundations twice, making the present foundation under that crib the third structure built for the purpose.

Another harrowing job was the building of the Lake View tunnel, which was completed in 1896 after eight years of effort. Two miles long, this 6-foot shaft was the first to be driven partly through solid rock, and it marked the introduction of pneumatic drills. The reason for descending into the limestone underlying Chicago was that Lake Michigan and various water pockets under its floor kept breaking into tunnels started through the clay.

The geological composition of Chicago is treacherous to engineers. Rock, for example, is reached 140 feet below Lake Shore drive, while at Western avenue it lies nearly at the surface. Much water is found at one spot; a mile away, almost none. In some locations the clay is hard, yet an abrupt bed of "swelling" clay may be encountered next to it—and that is a headache for the engineers.

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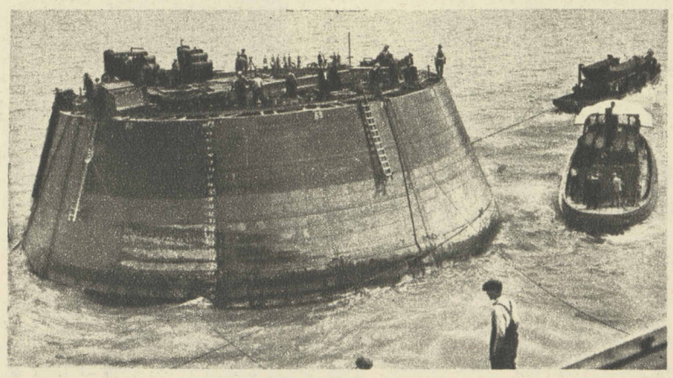
Not until 1907 was the air lock system perfected, enabling engineers to keep tunnels under air pressure as the digging advanced and thus minimizing the tendency of these natural enemies to burst in upon the workmen. The use of dynamite, which is the right-hand tool of the "hard rock" boys, also improved with the years. Today pneumatic drills bore holes ten or fifteen feet deep, which are filled with dynamite. After the charge is exploded the fumes are sucked out of the tunnel by electric fans. Rock shattered by the blast, called "muck," is now loaded into cars by machine. Formerly this was the hardest job in tunneling. Storage battery locomotives move the muck cars back down the tunnel on narrow-gauge tracks to a large vertical shaft, and there they are hoisted and dumped by power devices and the rock is hauled away by truck.

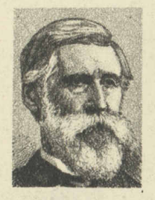
In spite of such enlightened methods, however, the builders of waterworks still have to face the unexpected and are continually tackling new adversities. Tragedy, while coming less frequently, is still familiar to them.

The worst catastrophe in the history of the water system occurred in January, 1909, at a



Installing the William E. Dever crib alongside Carter Harrison crib off Chicago avenue. The metal crib was towed into position and connected with a 16-foot tunnel under the lake. (Tribune photo.)

(Other photos and drawings courtesy Chicago Historical Society.)



Ellis S. Chesbrough

engineers thought that the putrid water of the Chicago river pouring into Lake Michigan might make it necessary to move the intake cribs still farther out from shore. But the building of the sanitary canal, connecting the river with the Mississippi system and reversing its flow, removed much of the danger, and the rest has been removed since by a gigantic new system of sewers which convey all of the city's sewage to huge treatment plants, where it is chemically treated and the solid part of it dumped, leaving the harmless liquid residue to flow southward with the river into the Gulf of Mexico.

The effectiveness of this handling of the problem is indicated by the sensational drop in the typhoid death rate just after the sanitary canal was opened in 1900. From 65 persons per 100,000 population before the opening of the canal, the annual death rate for the decade following its opening dropped to 22.7 persons per 100,000, and by 1922, with sewage treatment in operation, the typhoid fever germs were claiming only 1 victim a year out of 100,000.

Since then Chicago's health has been improved even more by the division of water purification, which supervises the testing of water at each of the twelve pumping stations that now pump water to the different parts of the city. After the water is carefully tested for purity at intervals of less than an hour, chlorine gas is forced into the water at the pumping stations in sufficient amounts to render it absolutely safe for drinking.

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Meanwhile the great Chicago water system of the present roars on unseen and unsung in clean channels far below the grime of the streets. The latest big unit, the 16-foot Chicago avenue tunnel, completed in 1936, is one of the greatest single engineering jobs in the world, and few people know anything about it. Running 130 to 200 feet below the surface, this 11½-mile tunnel was blasted out of bedrock with 3,000,000 pounds of dynamite. An eight-foot circus giant could stand on the shoulders of another eight-foot giant in the tunnel without bumping his head against the vaulted roof.

The extreme demands which at times the Chicago water supply system must meet and plan for is illustrated by the great stockyards fire of May, 1934. Ninety-three pieces of fire apparatus responded to the various alarms, and this constituted by far the greatest concentration of fire-fighting equipment ever known in history. According to City Engineer Loran D. Gayton: "The demand for water was three times that ever before recorded and far beyond any requirements called for by the National Board of Underwriters. . . . A maximum rate of 1,000 gallons of water a second was delivered by the fire department upon the burning area." He added: "The system was able to meet this extreme demand on a hot summer day and maintain pressures over the entire city."