THE WATER SUPPLY SYSTEM OF CHICAGO.

BY F. B. EMBREE.

It is not yet three-quarters of a century (November 10, 1834) since the Board of Trustees of the infant Chicago paid $95.50 for the digging of a well as a means of water supply. Outgrowing that, in January, 1836, the Chicago Hydraulic Company was incorporated by the State Legislature and given a charter which was to continue in force for seventy years, by the provisions of which lake water was to be furnished to Chicago. The works of this company were put in operation in the spring of 1842. They comprised a reservoir, about two miles of wood pipe and a 25 H. P. engine, the whole costing about $24,000.

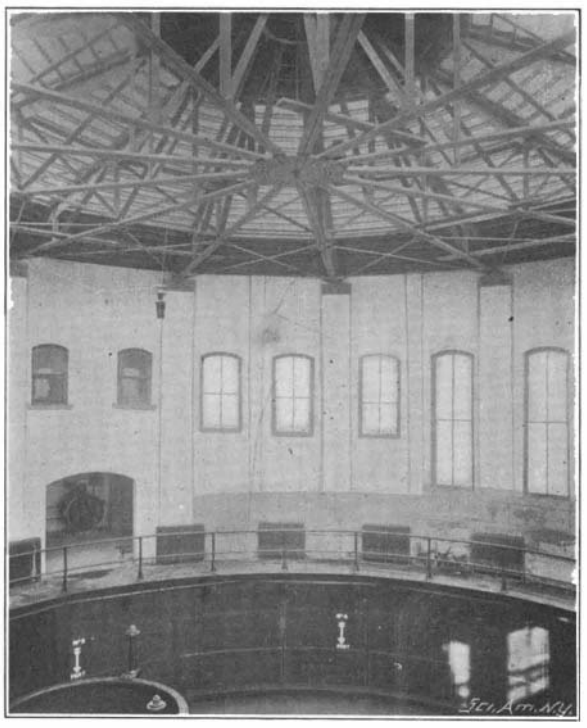
THE INTAKE CRIB COMPLETED.

This company, however, supplied only a portion of the south and west divisions of Chicago, and did not reach the north division at all. The inhabitants of the unsupplied sections were furnished with water either from the river, or by the "water-cart system" from the lake. Finally it became clear that the whole water supply needed to be managed by the city, and compromises having been agreed upon between the company and the city in 1852, the latter put its works into operation immediately.

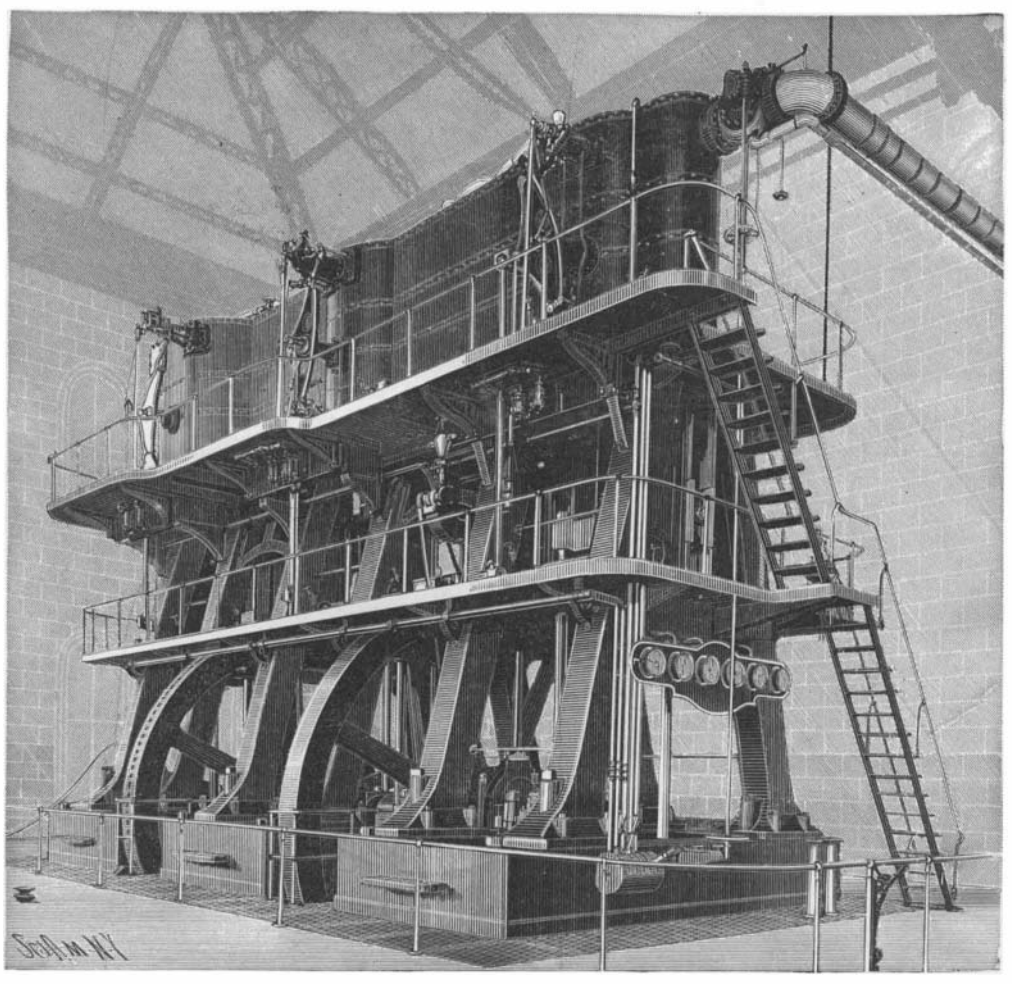
The north side pumping station at the foot of Chicago Avenue was the first station to be established. It began work in December, 1853, with a capacity of 8,000,000 gallons every twenty-four hours. The water came from an inlet basin on the lake shore cut off from the lake by a semi-circular breakwater with an opening to the southeast. There were three reservoirs holding from two to three days' supply. They were at LaSalle and Adams Streets, Chicago Avenue and Sedgwick Street, and Monroe and Morgan Streets. The first iron distribution pipe, 4 inches in diameter, was laid in 1852. In 1887 a shore-inlet tunnel 7 feet in diameter and 1,500 feet long, with an inlet shaft protected by a crib opposite to the north side station, was completed for use when the supply was endangered by ice, or from any other cause, at the two-mile crib. The addition of needed engines and other facilities to the north side station has kept this, the oldest and largest station in the city, in efficient use up to the present time. In 1869 the greater part of the station as it is to-day was finished. The style of architecture is castellated Gothic with heavy battlemented corners, executed with solid, rock-faced, ashlar stone and cut trimmings, with details of a massive and permanent character. The tower is the most imposing feature of the structure, and in the days preceding the sky-scraper epoch, a view of the lake and city from its top was thought to be very fine. A new lake tunnel, 7 feet interior diameter, extending from the crib to the north side station, was finished July 3, 1874, and in October of the same year it was extended under the land to the new pumping station at Ashland Avenue and Twenty-second Street (the west side station).

On November 6, 1876, the year in which the "Board of Public Works" was succeeded by the "Department of Public Works," with a single responsible head, the west side pumping station was put in operation, its capacity being 30,000,000 gallons per day. In 1884 this was raised to 60,000,000 by the addition of two new engines. The growth of the city's needs and the constant outlay necessary to satisfy them may be seen when this amount is compared with that actually pumped at this station for the year 1899, the amount reaching the enormous output of 19,281,301,400 gallons. It will be remembered that the first inlet basin to supply Chicago with water was quite near the shore, and although the city grew rapidly and packing houses and distilleries added their refuse to the Chicago River, and complaint was made by the citizens that the source of their water supply had become contaminated, no effort toward change was made until 1861, when the Board of Public Works entered upon its duties. A plan of filtration was first experimented with, but it was soon cast aside as impracticable, and it was decided to construct a tunnel, which would bring lake water from a distance sufficiently removed from the contaminating river deposits to insure its purity. It was thought that this could be accomplished by using a tunnel two miles in length. The horizontal diameter of the tunnel was fixed at 5 feet, that size offering a capacity sufficient to furnish 50 gallons of water per day to each person in a population of one million. Work was begun on this tunnel March 17, 1864, the introduction of pure lake water into the finished waterway being celebrated with appropriate public ceremonies March 25, 1867.

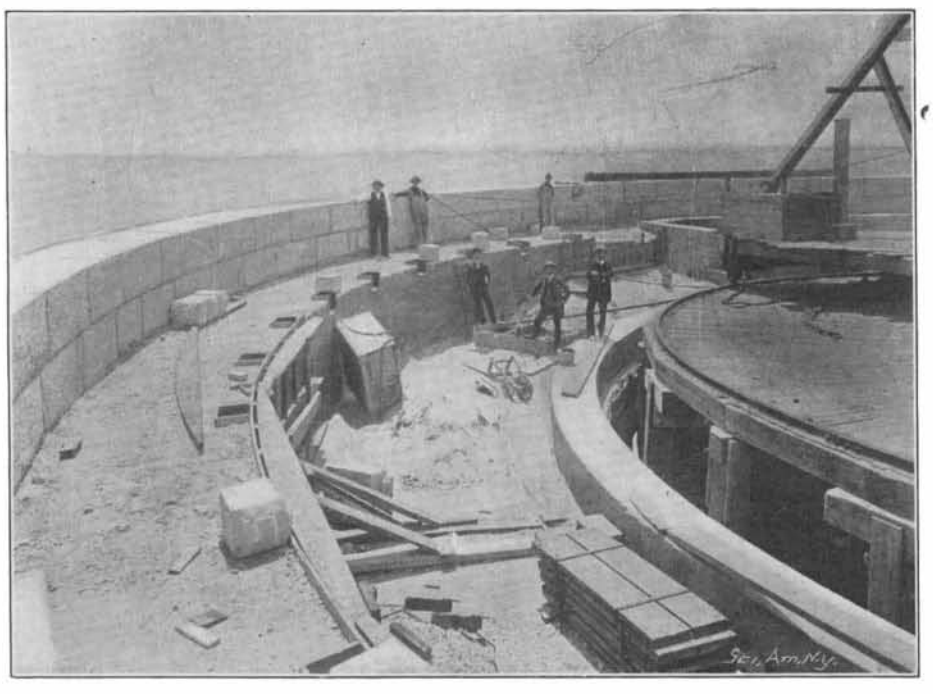
The present system of water pipe tunnels under the Chicago River was not originated until 1869. An accident occurred August 18 of that year, in which the water main crossing the river at Chicago Avenue was broken by the dragging anchor of a vessel, and the west side thereby deprived of water for



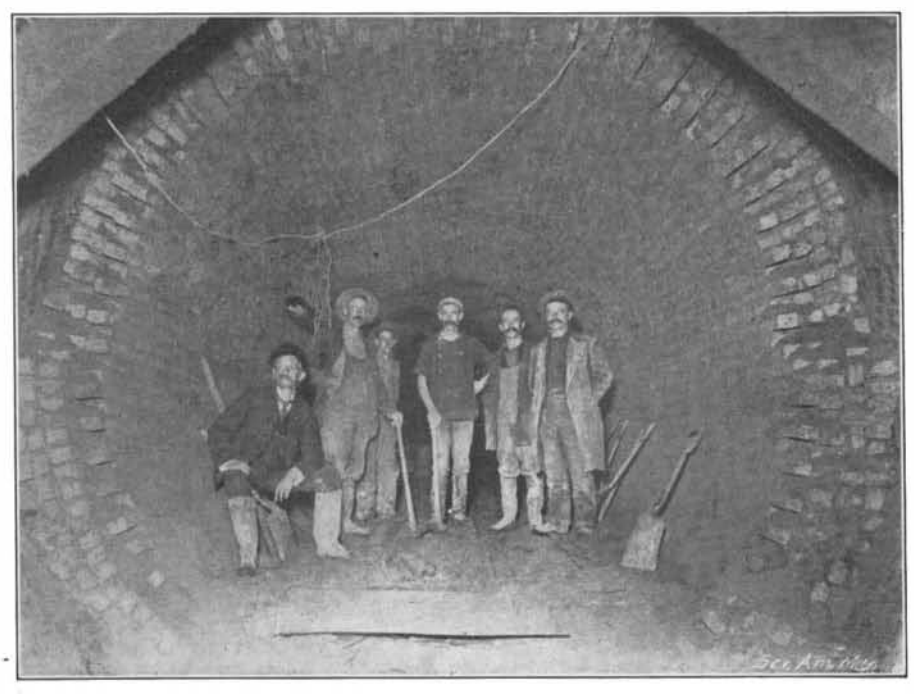
INTERIOR OF THE CRIB.



THE FOURTEENTH STREET PUMPING STATION.



NORTHEAST LAKE TUNNEL—INTAKE CRIB DURING PROCESS OF ERECTION—THE PARAPET.



NORTHEAST LAKE TUNNEL—INTERNAL DIAMETER 10 FEET.

three days. This brought out the necessity of tunnels under the river bed. Up to this time all pipes at intersections of the river had been laid on the river bottom. But the pollution of the water continued, and when the construction of the next tunnel was planned, in 1887, it was decided to make it 8 feet in diameter and to extend it four miles into the lake. The initial work was done in the same year on a shore shaft at the foot of Peck Court. The land ramifications connecting the shore shaft with the south side and central stations were nearly completed in 1888, but it was not until December 15, 1894, that the immense work, up to that time the greatest engineering enterprise undertaken by the city, was completed. The interdependence of pumping stations and feeding tunnels prevented the central pumping station at Harrison Street from doing full work before the four-mile tunnel was in operation, although it began service July 14, 1890. The Fourteenth Street station was built in 1890, and re-equipped in 1898.

But increased as were the facilities for water supply, the growth of Chicago afforded no chance for a breathing spell for the water supply department. July 15, 1889, the suburban towns of Hyde Park, Lake, Jefferson, and Lake View were annexed to Chicago, adding to its population 220,000 souls, and to its water works system the pumping stations of Sixty-eighth Street and of Lake View; one lake tunnel 6 feet in diameter and 8,000 feet long with a submerged inlet for Hyde Park and Town of Lake; one lake tunnel in process of construction, 6 feet in diameter, for Lake View and Jefferson, and about 350 miles of water pipe. Immediate extensions and repairs for the adequate water supply of this new territory were imperative. The original plans of the Lake View water department contemplated a tunnel 6 feet in diameter extending easterly from the foot of Sulzer Street to a point one mile from shore. After annexation and while the work was in progress, it was decided to extend the tunnel a mile further. In order to utilize the construction as soon as possible a temporary crib was sunk 6,000 feet from shore on the line of the tunnel and water obtained from this point, work meanwhile progressing from a temporary shaft to the outer or permanent in-take crib previously sunk. This tunnel was completed in July, 1896, and the intermediate crib abandoned and finally removed in 1899. The construction, appointment, and furnishing of the Carter H. Harrison crib mark it as the most modern and efficient of the Chicago cribs. Its cost, including substructure, superstructure, and landing, was $192,-441.40.

In 1895 it was again found necessary to plan for the construction of two additional pumping stations to relieve the sufferings of the remote west and northwest sections of the city due to an inadequate water supply. As a feeder for these, it then became necessary to build a new lake tunnel, which is divided into a lake section and three other sections covering the land ramifications. The lake tunnel extends to the Carter H. Harrison crib, and was completed in January, 1899. Section one of the land tunnel was completed in 1897, number two and number three in 1900. The capacity of the lake tunnel is 200,000,000 gallons per 24 hours, and the cost of the new service was $4,986,266.37. With the completion of the new tunnels and pumping stations a population of 3,500,000 can be supplied with 150 gallons of water per day to each person, and there will still be ample reserve machinery.

PROVISIONING A TRANSATLANTIC LINER.

Not by any means the least impressive evidence of the huge size to which the modern transatlantic steamship has grown is to be found in the graphic representation, on the front page of this issue, of the bewildering amount of provisions that have to be taken aboard for a single trip across the ocean. A mere tabulation of the various kinds of food which go to replenish the ship's larder, during the few days which she spends in port, fails to convey any adequate idea of the vast amount of stores taken aboard. Our pictorial representation is, of course, purely imaginary, particularly as regards the live stock; the beef, mutton, game, etc., being received on the ship in the dressed condition, no live stock whatever being carried. The drawing was made up from a list of the actual amount of provisions carried on a recent eastward trip on the Hamburg-American liner "Deutschland," and the number of live stock which contributed to meet the supplies for one voyage was estimated from the actual number of cattle, sheep, etc., that would be required to make up the total weights in dressed meats given in the table. With the exception of the live stock, the provisions are shown in the actual shape in which they would be taken on board.

The dimensions of the vessel are: Length, 686 feet; beam, 67 feet, and displacement, 23,000 tons; her highest average speed for the whole trip is 23.36 knots, and she has made the journey from Sandy Hook to the Lizard in five days, seven hours and thirty-eight minutes. In considering the question of feeding the passengers on a vessel of this size, the thought is suggested that there are other hungry mouths within the hull of the ship besides those to be found in the dining saloons of the passengers and the messrooms of the crew; mouths that are so voracious that they require feeding not merely at the three regular meal hours of the ship, but every hour of the day and night, from the time the moorings are cast off at one port until the vessel is warped alongside at the other. We refer to the 112 furnaces in which the fuel of the sixteen boilers in the boiler-room is consumed at the rate of 572 tons per day. Now, although the voyage from New York to Hamburg lasts only six or seven days, according to the state of the weather, the bunkers of the ship are constructed to hold a sufficiently large reserve of coal to cover all contingencies, her total coal capacity being about 5,000 tons; and at each voyage care is taken to see that they are pretty well filled.

The total number of souls on board of the vessel when she has a full passenger list is 1,617, made up of 467 first cabin, 300 second cabin, 300 steerage and a crew of 550, the crew comprising officers, seamen, stewards and the engine-room force. Sixteen hundred and seventeen souls would constitute the total inhabitants of many an American community that dignifies itself with the name of "city," and it is a fact that the long procession which is shown in our illustration, wending its way through the assembled provisions on the quay, by no means represents the length of the line were the passengers and crew strung out along Broadway or any great thoroughfare of this city. If this number of people were to march four deep through Broadway, with a distance of say about a yard between ranks, they would extend for about a quarter of a mile, or say the length of four city blocks.

To feed these people for a period of six days requires, in meat alone, the equivalent of fourteen steers, ten calves, twenty-nine sheep, twenty-six lambs, and nine hogs. If the flocks of chickens, geese and game required to furnish the three tons of poultry and game that are consumed were to join in the procession aboard the vessel, they would constitute a contingent by themselves not less than 1,500 strong. The ship's larder is also stocked with 1,700 pounds of fish, 400 pounds of tongues, sweetbreads, etc., 1,700 dozen eggs and 14 barrels of oysters and clams. The 1,700 dozen of eggs packed in cases would cover a considerable area, as shown in our engraving, while the 1,000 bricks of ice cream would require 100 tubs to hold them. Of table butter there would be taken on board 1,300 pounds, while the 2,200 quarts of milk would require 64 cans to hold it, and the 300 quarts of cream 8 cans.

In the way of vegetables there are shipped on board 175 barrels of potatoes, 75 barrels of assorted vegetables, 20 crates of tomatoes and table celery, 200 dozen lettuce; while the requirements of dessert alone would call for 4¼ tons of assorted fresh fruits. For making up into the daily supply of bread, biscuits, cakes, pies, and the toothsome odds-and-ends of the pastry cook's art, there are taken on board at each trip 90 barrels of flour, each weighing 195 pounds, this item alone adding a weight of 8½ tons to the cooks' stores. To this also we must add 350 pounds of yeast and 600 pounds of oatmeal and hominy.

Under the head of liquids the most important item is the 400 tons of drinking water, whose bulk is adequately represented by the circular tank shown in our engraving. This is supplemented by 12,000 quarts of wine and liquors, 15,000 quarts of beer in kegs, besides 3,000 bottles of beer. Last, but not by any means least, is the supply of 40 tons of ice.

Of course, it will be understood that, as in the case of the coal, it is not to be supposed that all of this supply will be consumed on the voyage. There must be a margin, and a fairly liberal margin, of every kind of provision. Moreover, the extent to which the larder and cellar are emptied will vary according to the conditions of the voyage. In tempestuous weather, where the trip is a succession of heavy gales, and the dining room tables are liable to be practically deserted for two or three days at a stretch, the consumption will be modified considerably. Stormy voyages of this character, after all, occur at infrequent intervals, and as a rule the supplies are pretty well consumed by the time the passage is over.

Fire from Waste Paper.

The deterioration in the quality of paper increases the liability of fire wherever waste paper is accumulated in any quantity. Most modern paper is made from wood and other vegetable fibers which, chemically, are not very different from the component material of a hayrick. If the waste paper is stacked in large quantities, and especially if it happens to be a little damp, heating takes place just as with a prematurely stacked hayrick, and spontaneous combustion may at any time break out in flame, as it has often been known to do in the farmyard, and of late years the greatest care and vigilance has been necessary to guard against it.

Engineering Notes.

Ten American locomotives have just been delivered to the Paris-Lyons Railway.

Acetylene black produced from the carbon of acetylene is of excellent quality, fineness and purity. By reason of its very fine division acetylene black seems particularly suited for the production of India ink.

During the year 1900 the shortest passage of a sailing ship from London to Calcutta was 82 days, and the longest 199 days. The shortest passage from London to San Francisco was 109 days, and the longest 203 days. The shortest trip from San Francisco to London was 96 days, and the longest 181 days.

A new solder is being introduced by an English concern. It consists of an alloy composed of pure metals mixed in the most efficient proportion, and incorporated with it is the necessary amount of rosin. The solder is made in the form of a tube with a narrow bore, the central cavity being occupied by the flux.

We learn from The Engineer that railway unpunctuality is by no means unknown in Russia. On the Vistula line in 1900, out of 348,933 trains which were run, 52,020, or 15 per cent, left the station before time; 74,909, or 21 per cent, arrived late. The other lines have not much more to boast of. The only fairly punctual line is the Warsaw-St. Petersburg one, on which only 7 per cent of the trains were late.

Arrangements are in progress for the visit of a representative commission of British artisans to this country. It will be their business to make a tour of observation among our varied industries. The commission has been organized through the medium of a London weekly called "Red Letter." The men are elected by popular vote. Their itinerary will include a visit to the Pan-American Exposition.

When the British Chancellor of the Exchequer levied the tariff of twenty-five cents upon each exported ton of coal, it was maintained by the various colliery owners that a heavy blow had been dealt to the English industry. As a matter of fact, however, since the duty was imposed the exports of coal from Great Britain have increased considerably, especially to Germany and France. During the month of April 620,000 tons of coal were shipped to France, while the quantity for the first four months of the present year aggregates 1,882,880 tons, representing a value of $7,737,-400. The shipments to other parts of the Continent have been equally heavy.

A Baltic-White Sea Canal is proposed in order to more rapidly develop the vast territory of Archangel. It is contemplated to build the canal large enough to admit vessels of ocean tonnage. The canal would also be of great value to the Russian navy in time of war. If it is carried out, the total length of the canal will be 598 miles; 304 miles of the route will be formed by lakes. The canal will follow the bed of the Neva as far as St. Petersburg, crossing Lake Ladoga and following the Svir, which unites Lakes Ladoga and Onega. Different watercourses will then be utilized, the channels being enlarged and deepened until the White Sea is reached at Soroskaya. It is estimated that the work can be completed within a year, and that the cost would be $10,300,000.

A scheme for supplying the manufacturing districts of South Staffordshire with gas made by the patent Mond process is being considered by the British government. The gas is not to be employed for illuminating purposes, but is to be devoted to heating and manufacturing requirements entirely. The Mond gas is manufactured from an inferior quality of coal at a very cheap rate. The President of the Society of Chemical Industry of Great Britain, who is interested in the scheme, stated before the Parliamentary Committee that whereas now 50,000,000 tons of coal are annually consumed for manufacturing purposes in this district, the necessary steam and motive power will be obtained from Mond gas distilled from 10,000,000 tons of coal, thus effecting a considerable economy in the consumption of coal. The gas is to be supplied at the low price of four cents per 1,000 cubic feet.

Two derailments which have occurred recently on the Siberian Railway are a further proof, if any were needed, that the line has been too lightly constructed to enable it to carry the heavy locomotives now running on it, to say nothing of the ever-increasing freight traffic. The first derailment referred to was caused by a "burst rail," and, of course, until the entire line has been relaid with heavier and sounder rails, there will be always the risk of other "burst rails," causing loss of life and interruption of the traffic, says The Engineer. The second accident, which is the fifth of this nature on the new line, shows that the supervision exercised over the traffic is far too weak. The control of the line is in the hands of one man. Both the people and the press of Siberia have come to the conclusion that to insure the proper working of the line in the best interests of the country, the Siberian Railway ought to be divided into three or four separate and independent sections.