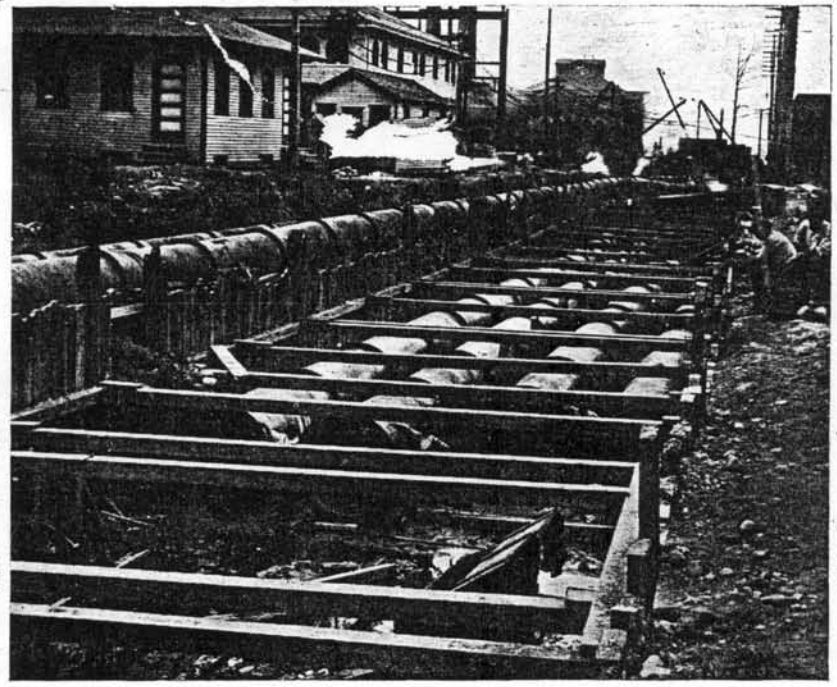
PHILADELPHIA



Giant Pumping Mains from Lardner's Point; four of 60-inch diameter, one of 48-inch diameter, one of 30-inch diameter; combined, these six pipes have a daily capacity of 300,000,000 gallons of water

VOLUME V JULY, 1911 NUMBER 1

PUBLISHED BY THE CITY GOVERNMENT

In addition to the work of recording contracts and granting licenses, the Bureau of Contracts and Statistics is given the work of collecting, compiling and placing before the taxpayers information touching the various departmental activities. To bring such information quickly to the notice of taxpayers it has been thought proper to issue a series of publications dealing with the various divisions of municipal work. The first number, issued July, 1909, contained the Bullitt Bill; August, History of the Parkway; September, Department of Public Health and Charities; October, Public School System; November, Philadelphia's Fire Department; December, Police Department; the number issued in January, 1910, described Department of the Mayor; February, Select and Common Councils; March, Home of the City Government; April, Pleasure Grounds of the People; May, Bridges of a Great City; June, Water Supply of a Great City; July explained what the City does for the Pleasure of the People; August, Electrical Bureau of a Great City; September, Removal of Grade Crossings and Increase of Rapid Transit Facilities; October, Department of Wharves, Docks and Ferries; November, Highways of a Great City (Outlying Business Districts); December, Highways of a Great City (In the Heart of the City); January, 1911, Highways of a Great City (The City of Homes); February, Highways of a Great City (The Schuylkill River); March, Philadelphia's Comprehensive Plans; April, Philadelphia's Free Libraries; May, Progress of Philadelphia's Comprehensive Plans; June, Underground Philadelphia (Main and Branch Sewers). The present number is devoted to Underground Philadelphia (Water Supply System). "Philadelphia" may be obtained from George W. B. Hicks, Editor, Bureau of Contracts and Statistics, Rooms 203-205, City Hall, Philadelphia.

UNDERGROUND PHILADELPHIA

No. 2.—WATER SUPPLY SYSTEM

While the drift of population from the country districts to the cities is developing many new problems difficult of solution for those in control of municipal administration, some of the most important and far-reaching influences of this new movement of population find expression in the new importance given to old problems—problems which have confronted administrators since mankind first began to congregate in towns, and by such action expressed the gregarious instinct common to all ages and all peoples. One of the old problems that has received this new emphasis and importance through the rapid growth of cities is that which covers the distribution of water. Public attention has been so largely concentrated of late years upon a world-wide effort to purify the water supply of great cities, and coincidently increase available water supply, that the general public has failed to note the less picturesque, less conspicuous, problem represented by the distribution of a generous supply of pure water over a large area to an increasingly critical body of population. While the majority of people in Philadelphia are familiar with the capacity and cost of Philadelphia's great filter plant at Torresdale, and the supplemental work represented by the Belmont and other filters, together with the promised help of the filter plant at Queen Lane, now rapidly approaching completion—representing an expenditure of 28 million dollars—few realize the full meaning of the fact that not a drop of water from these great supply points can become of use in the preservation of life, and the mitigation of certain evils inseparable from residence in crowded sections, until sixty-five million gallons of water, an amount equal to the total daily capacity of the Upper Roxborough and Belmont Filter Plants, is pumped into the 1,600 miles of water mains which form an inconspicuous, but increasingly important, part of that underground Philadelphia which it is the purpose of these papers to illustrate and explain.

Indeed, the sewer, treated in the June issue of "PHILADELPHIA," goes hand in hand with the water main, the subject of this paper, in opening the way for the building of those homes which are the heart of any city, each being a necessary factor in the life of the community, each of no value lacking the support of the other—one supporting life, the other preserving life. And both water and sewer problems have this in common; they find in Philadelphia their highest expression, owing to the circumstance that in Philadelpjhia individual home life has reached its finest manifestation, resulting in necessity for a greater per capita sewer connection and water connection than is to be found in any other center of population throughout the world. Each system has also this common factor—both are influenced, in a large degree, by the great extremes of elevation found within the limits of Philadelphia's area of 129½ square miles, elevations ranging from level of the river to 450 feet above that level. Moreover, both problems are complicated by the fact that owing to Philadelphia's great age, 228 years, and the further fact that within her large area there has been a coincident development of populous centers in widely separated sections of that area, there remain, even at this late day, wide stretches of undeveloped country, separating sections of closely built up city. Each problem has also to share the common difficulties arising from the circumstance that whereas one ward or political unit in the City has a population at the rate of 315 per square mile, another has a population of 134,000. Each problem is also influenced largely by the changing ideals regarding service and the improvements in means whereby that service is rendered, born of discovery and invention all over the world. The two systems differ radically, however, in the great fact that the one, the water system, delivers that which is necessary to support life; the other, sewerage, carries away that which is a menace to life. In this respect, the one may be called positive, the other, negative.

Realizing, then, the important part which a system of water distribution plays in the day by day life of a great city, let us see, first of all, what are the peculiar features in water distribution within the limits of the City of Philadelphia. In the first place, there is a population of 1,549,008 to be served, a population from tradition and present-day sentiment wedded to an extravagant use of water. Second, this population occupies, for residential purposes, 346,000 homes, facing on more than 1,800 miles of streets, there being an average of more than one bath room for every house so occupied. Further, the total number of buildings to be supplied with water in the City of Philadelphia is over 375,000. Third, manufacturing interests constitute the backbone of Philadelphia's commercial body, and water being a necessary factor in all manufacturing, the supply of water to factories located in nearly all sections of this large area offers a peculiarly troublesome problem to the administration. Fourth, the face of the City shows a variation in altitude to be served ranging from land at high water level to land 450 feet above that level, with points of service 23 miles apart. To make possible the handling of this tremendous problem of water distribution—the distributing in each day of 305 million gallons of water, or an average of more than 200 gallons of filtered water for each man, woman and child living within City limits—Philadelphia is divided into certain areas of distribution, each with its own source of primary supply in the way of a filtration plant, and secondary supply in the way of a reservoir or reservoirs, the water utilized in this service being drawn from the Delaware and Schuylkill rivers, 70 per cent. coming from the Delaware and 30 per cent. from the Schuylkill.

This water distribution is divided as follows:

District No. 1 covers territory extending from the extreme northeastern boundary line on the Poquessing creek to the extreme southern point of the City between the two rivers, or a district bounded by the Back Channel at League Island. This district varies in width in the northeastern section, consisting of the territory between the Bustleton turnpike and City line. The narrowest section is between the Delaware river and Broad street, just north of Callowhill street and south of Jefferson street, broadening out below Callowhill street to embrace the whole district between the two rivers as far south as League Island.

District No. 2 takes in the northwestern section, and is bounded by City line on the north and west, the Schuylkill river on the southwest, Allegheny avenue on the south and the Philadelphia and Reading Railway line on the east to York road.

District No. 3 covers the remaining portion of the City lying west of the Schuylkill

river and south of Allegheny avenue, serving all territory between Cobb's creek, Darby creek and Schuylkill river.

District No. 4 is near the heart of the City, measured by the center of population, serving the section bounded on the south by Callowhill street, north by Allegheny avenue, west by Twenty-seventh street and the Pennsylvania Railroad, and on the east by Broad street as far north as Jefferson and Ninth street, and Sixth street above that point.

District No. 5 serves a section also near the heart of the City, bounded on the west by the Schuylkill river, on the north by Allegheny avenue, on the east by Twenty-seventh street and Pennsylvania Railroad.

District No. 6 includes the extreme northeastern corner of the City, bounded on the north and east by the Poquessing creek, on the east by the Delaware river, on south by Dark Run lane, on west by Frankford avenue, Cottman street and Bustleton pike.

District No. 7, a small triangle on the northern boundary line of the City between York road and Green lane.

District No. 8, a small, irregular body of land lying on the western boundary just to the east of City avenue.

The sections have as sources of supply: No. 1, Delaware river from the Torresdale filters, with secondary sources the Wentz Farm Reservoir in the northern section of the City; No. 2, the Schuylkill river as primary source, with the Roxborough filters and Queen Lane Reservoir filters as subsidiary or secondary source; No. 3, as primary source the Schuylkill river through the Belmont filters, George's Hill Reservoir acting as secondary source; No. 4, Delaware river its primary source through the Torresdale filters, the Oak Lane Reservoir; No. 5 has the Schuylkill river as primary source, with the Queen Lane Reservoir as secondary source; No. 6 is supplied by the Philadelphia and Bristol Water Company; No. 7, Oak Lane Water Company; No. 8, Overbrook Water Company.

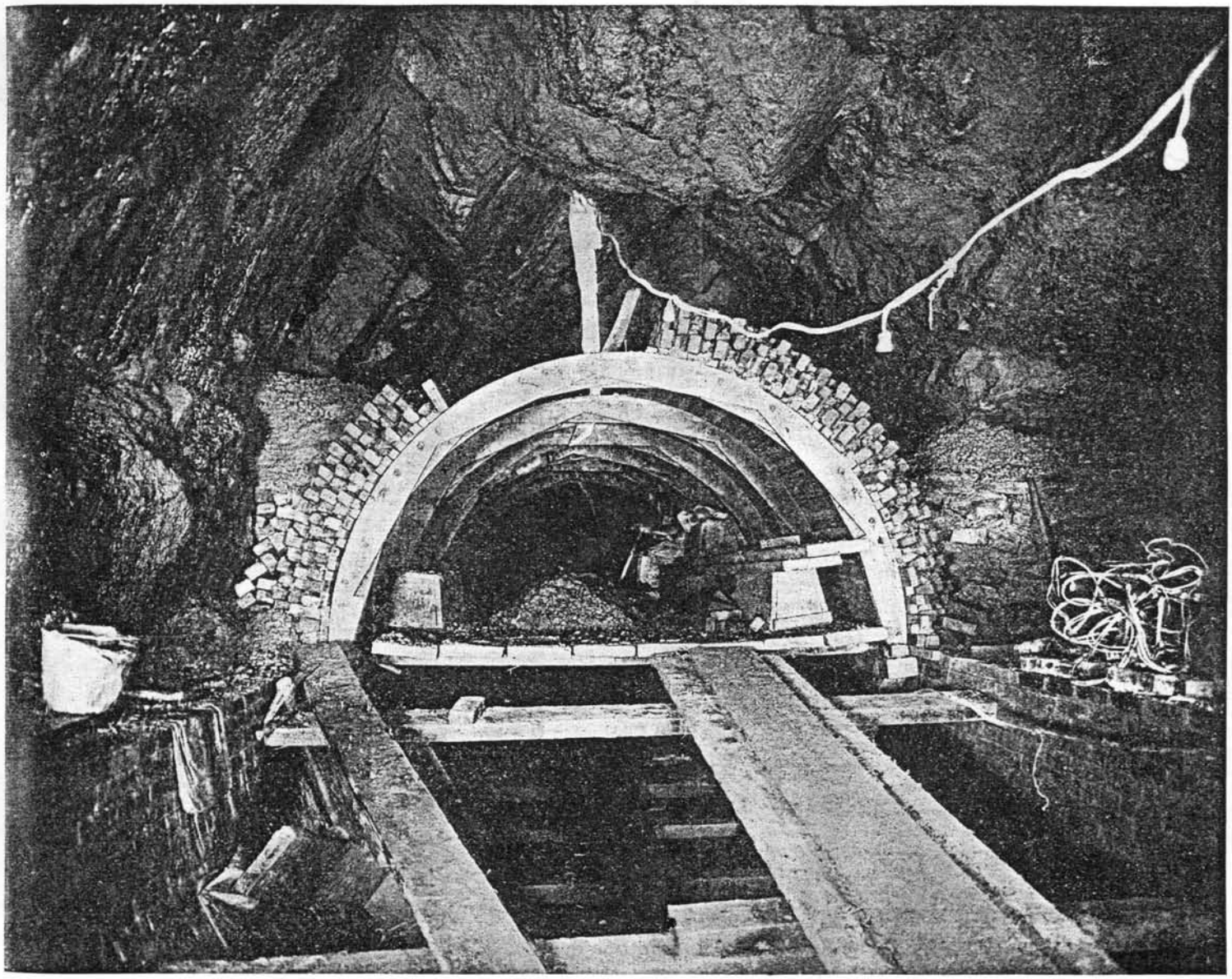
Another important division of underground Philadelphia which can be properly grouped with the water distributing system, although differing in important respects therefrom, is that represented by the thirty-six miles of pipe line used in connection with the high pressure service, which forms a leading feature of Philadelphia's system of fire protection.

This feature is, in a way, a connecting link between the underground Philadelphia of the sewer system, which protects life from attack, and the underground water distributing system, which preserves life. For, in actual operation, it is a distinct protection to those great employment agencies which furnish the means whereby people live, through employment and resultant wages. Moreover, it plays an important part in protecting that which represents accumulated wealth, in the shape of important buildings.

This underground system of water mains devoted exclusively to the fire protection service, and utilizing raw instead of filtered water for its beneficent work, is divided into two sections—one operating in the congested district of the City, between Walnut and Race streets, the other operating in the mill district to the north and east.

In the system of fire protection mains, the congested district, Walnut to Race streets, utilizes 5.956 miles of 8-inch pipe, 4.356 miles of 12-inch pipe, 1.16 miles of 16-inch pipe and .0272 miles of 20-inch pipe, the united capacity of these mains being 244,516 gallons; the number of fire hydrants located on the line being 231.

The fire service in the mill district utilizes



SECTION IN GREAT TORRESDALE CONDUIT, showing rock excavation and brick work; invert in place and construction of arch. This conduit is nearly three miles in length, ten feet seven inches in diameter, and over 15,000,000 bricks were used in its construction; it is built 120 feet below level of land. It carries the filtered water to the giant pumps at Lardner's Point.

5.85 miles of 8-inch pipe, 8.31 miles of 12-inch pipe, 3.18 miles of 16-inch pipe and 7.87 miles of 10-inch pipe, the united capacity of these mains being 893,346 gallons, the number of fire hydrants located on the line being 463.

A detail of Philadelphia's underground water distribution service worthy of note here is the circumstance that the City has to-day in operation 16,288 fire hydrants, utilized not only in fire-fighting, but in the flushing of streets, and representing a very heavy demand upon the City's water-carrying system.

THEN AND NOW—Old wooden pipes recently removed from Market street near City Hall; these pipes were laid in 1801. Prior to 1817 all water mains in Philadelphia were made of wood, and as late as 1845 there were still in use 45½ miles of wooden main, although the City had then a population of nearly half a million.

Another detail of interest is the character of pipe used in this distribution of water from the general central supply plants to the great army of homes and business edifices located within this City of 129½ miles of area. This pipe ranges in size from one inch to sixty inches in diameter, showing a total length of 8,698,179 feet, or 1,647.38 miles, nearly three-quarters of this amount, or 5,821,558 feet, being six inches in diameter.

Few people realize the important work represented by the Torresdale conduit. In the first place, it is the great connecting link between the largest filtration plant in the world, with a daily capacity of 220,000,000 gallons, with its sixty-five separate filters, each three-quarters of an acre in extent, and the giant pumping station at Lardner's Point, with its sixteen immense pumps and daily capacity of 297,000,000 gallons. The conduit itself represents a piece of engineering and construction work equivalent to a full size railway tunnel one and one-half miles in length, and its daily capacity of water carried represents a volume of water sufficient to fill 38,000 miles of six-inch water main, the size main constituting 5,821,558 feet out of the City's total of 8,698,179 feet of all kinds of pipe. This equivalent in 6-inch pipe represents more than sufficient pipe to circle the globe 1½ times, and puts in concrete form the immense quantity of life-supporting water carried through this wonderful conduit between Torresdale and Lardner's Point.

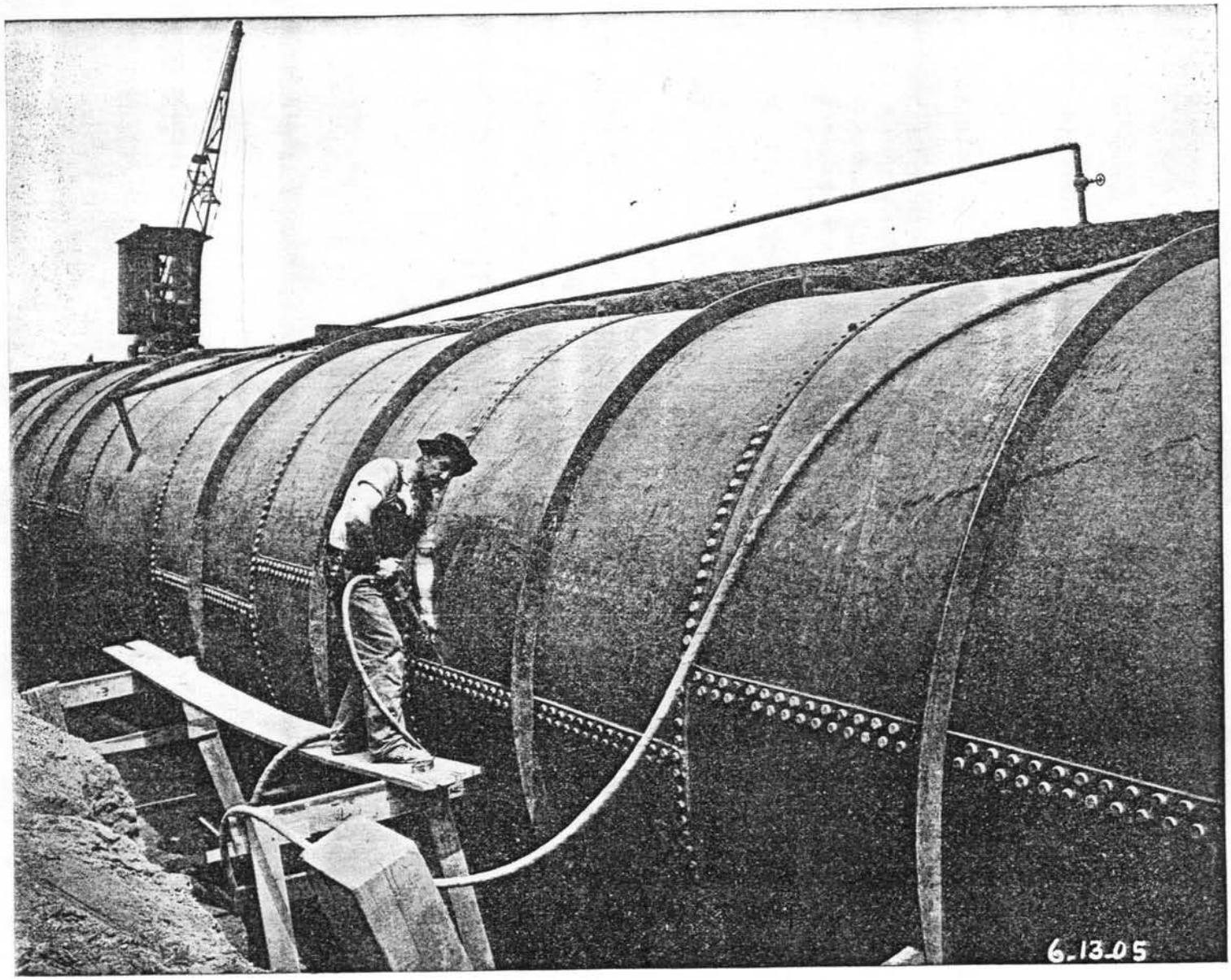
In the construction of this conduit more than 15,000,000 bricks were used, and the expense averaged about $100 per lineal foot, the average depth below surface of this conduit being 130 feet. All in all, it is one of the great underground facilities of a great city, and would be so classed over the world.

Coming a little closer to the subject, the conduit's size challenges attention, for the total length of the conduit is 13,809 feet between end shafts, or 2.615 miles. The interior diameter of the tunnel is 10 feet 7 inches. This tunnel, where it first takes water from the great filter beds, is 127 feet below the ground surface, while at the point where it delivers its filtered water to the great pumps at Lardner's Point the tunnel is 10 feet nearer the surface of the ground, its construction on a rising grade being adopted to prevent possibility of air locks. The great shaft which carries the water from the filtered water basins at Torresdale is of the same diameter as the conduit. That at the Lardner's Point end for delivery to the pumps has a diameter of 21 feet, for the upper 40 feet, decreasing in funnel shape to the tunnel's diameter of 10 feet 7 inches. Two connections are made from this shaft, one 14 feet, the other 7 feet in diameter, the connections being made of riveted steel bolted on to cast-iron nozzles. The building of the Torresdale filter plant worked a revolution in Philadelphia's whole system of water supply, not merely because it brought to the City a generous supply of filtered

water, but also because it changed the chief source of supply from the Schuylkill river to the Delaware river, and thus forced a rearrangement of the whole water distributing system of the City. To meet the changed conditions resulting from the construction of the Torresdale plant it was necessary to build three lines of 60-inch cast-iron pipe, each three miles in length, and to lay 22 miles of 48-inch pipe, a system of piping which alone is longer than the distance separating Philadelphia and Trenton, N. J. Owing to the circumstance that this new system of water mains played a vital part in the life of the City, possibility of accident was minimized by the building on the lines of the 60-inch pipe, about 4,000 feet apart, ten valve chambers, each chamber containing a system of 48-inch valves, so arranged that either line of pipe entering the chamber could be thrown out of service without interfering with the operation of the other lines, thus making it possible to examine and repair any part of the distributing system without interfering with the other parts thereof. These chambers are all constructed of concrete and each contains from eight to seventeen 48-inch geared valves. The ordinary daily flow of water through this great conduit between the Torresdale filters and Lardner's Point pumping station amounts to 210,000,000 gallons.

Passing from the large to the little in this great question of water distribution, it is interesting to note that the insignificant water paves or openings in the streets for the purpose of washing pavements to-day number in round figures 100,000 within City limits, using 780 gallons every hour of service, and, if all in service at once, representing $3,000 an hour cost to the taxpayers, or a consumption of filtered water during this one hour of service of 78,000,000 gallons, an amount of water nearly twice the daily filtering capacity of the Belmont filter, which supplies the whole of West Philadelphia. When it is remembered that there are to-day separate connections with 315,300 homes, each with its possibilities of pipe and valve trouble to contend with, the service performed by the water distribution system of the City appears in its true light as one of the great factors of present-day civilization.

To sum up the situation, we have here in Philadelphia, buried out of sight in that great underground city which makes possible the growth and development of the overground City, in round numbers, 8,700,000 feet, or 1,650 miles, of water pipe, ranging in size from one inch to eleven feet in diameter. Through this network of underground transportation each day 305,000,000 gallons of water are distributed to 315,300 separate buildings, the amount delivered being equivalent to more than 200 gallons of water for each man, woman and child within City limits, the cost of taking this water from the primary sources in the river, filtering from all impurity, and delivering within the home, being less than one cent a day per capita, or one-half cent per hundred gallons. This great system of distribution must be kept in repair without seriously disturbing traffic in overhead streets; must be so constructed as to allow of repairs to broken mains without cutting off the daily supply of water necessary to life in a large city. From the small lawn sprinkler which plays its part in adding to the beauty of the smallest lawn in front of the smallest home, up to the largest delivery of water to some great factory, this service plays its part in making Philadelphia the greatest City of Homes on the face of the earth.



THEN AND NOW—Largest water pipe in use in Philadelphia in the year 1911; this pipe is eleven feet in diameter, of riveted steel surrounded by concrete. It has a capacity of 300,000,000 gallons daily.

MAP INCOMPLETE:
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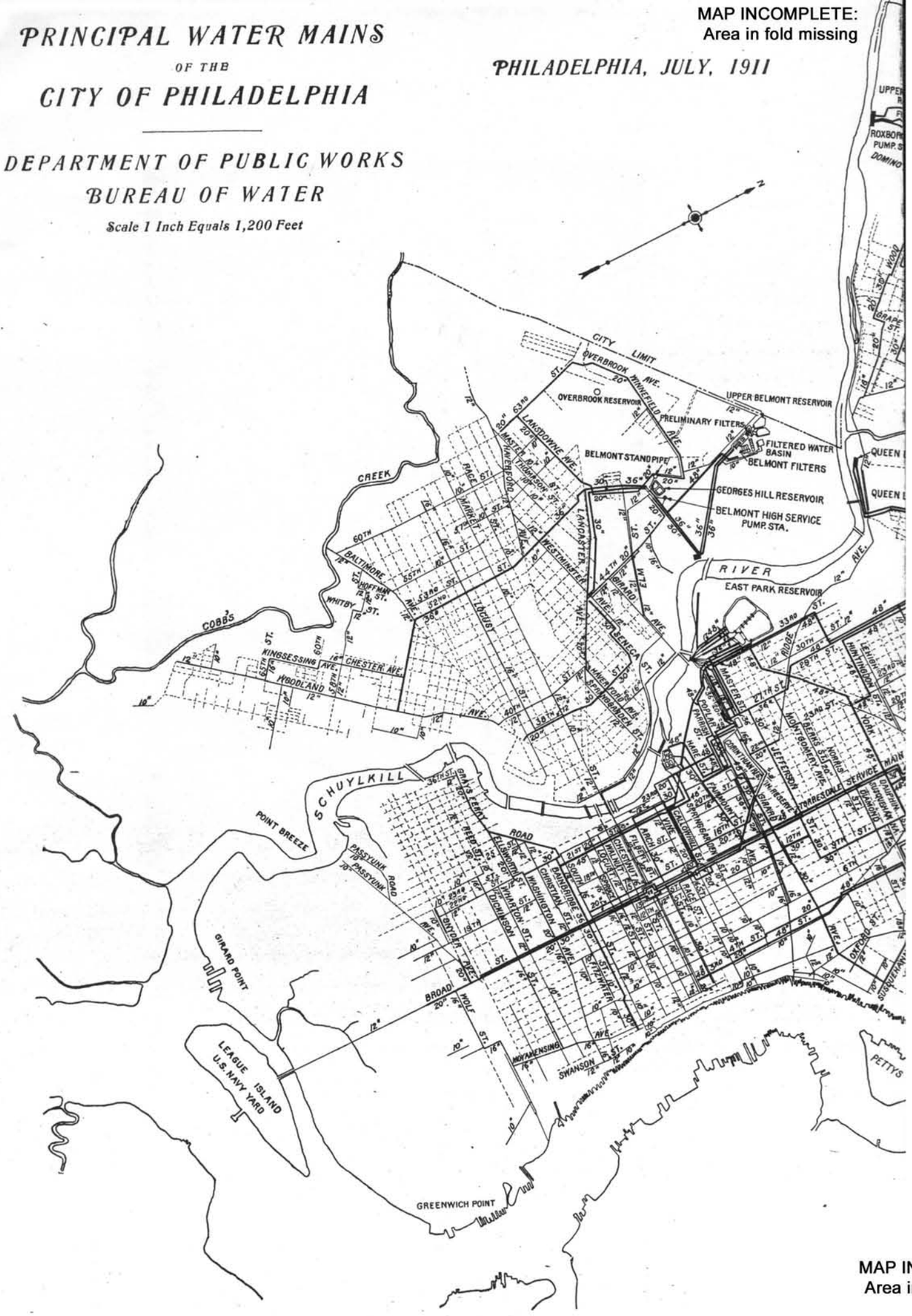
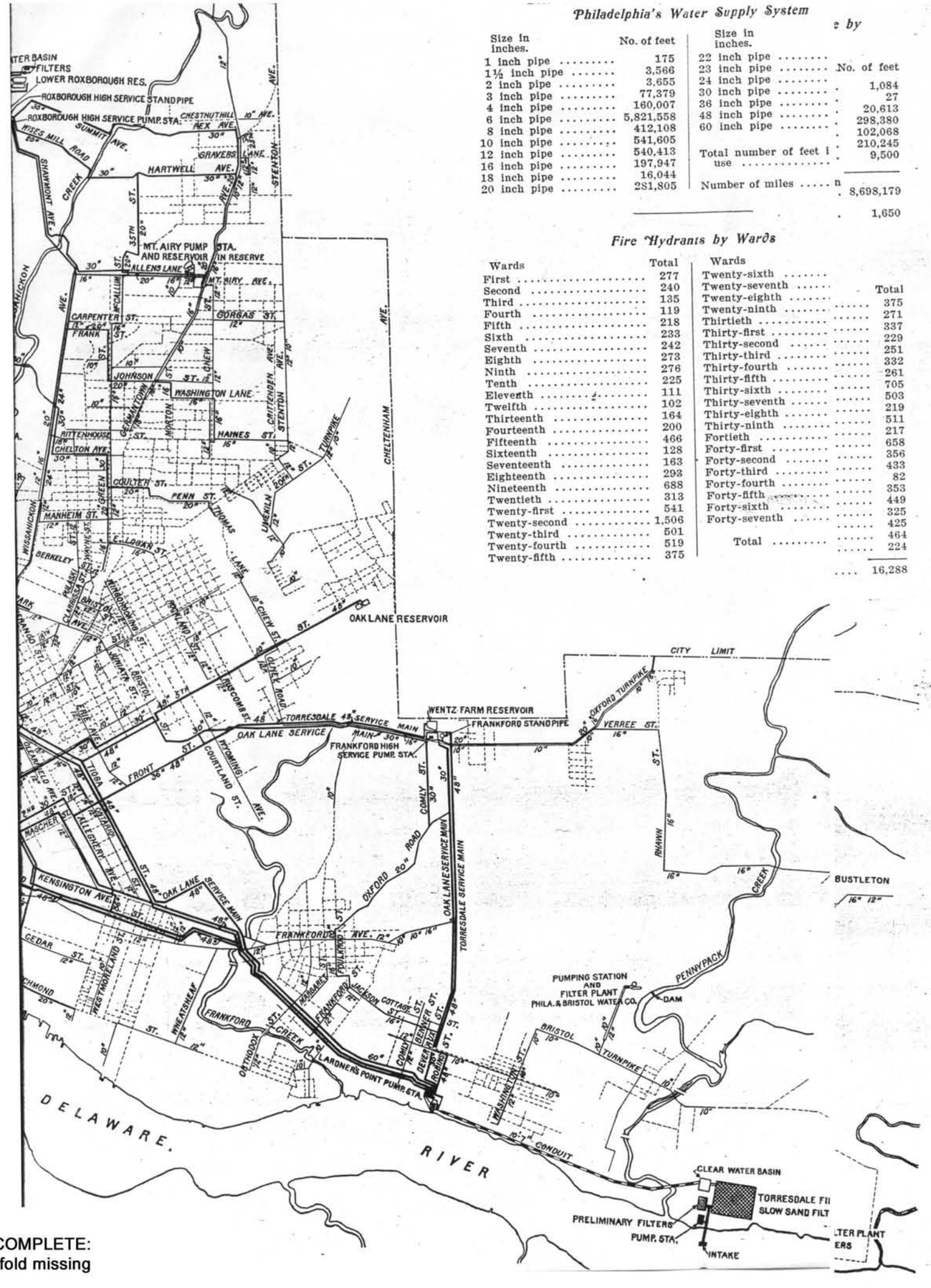
PRINCIPAL WATER MAINS
OF THE
CITY OF PHILADELPHIA

PHILADELPHIA, JULY, 1911

DEPARTMENT OF PUBLIC WORKS
BUREAU OF WATER

Scale 1 Inch Equals 1,200 Feet





MAP INCOMPLETE:
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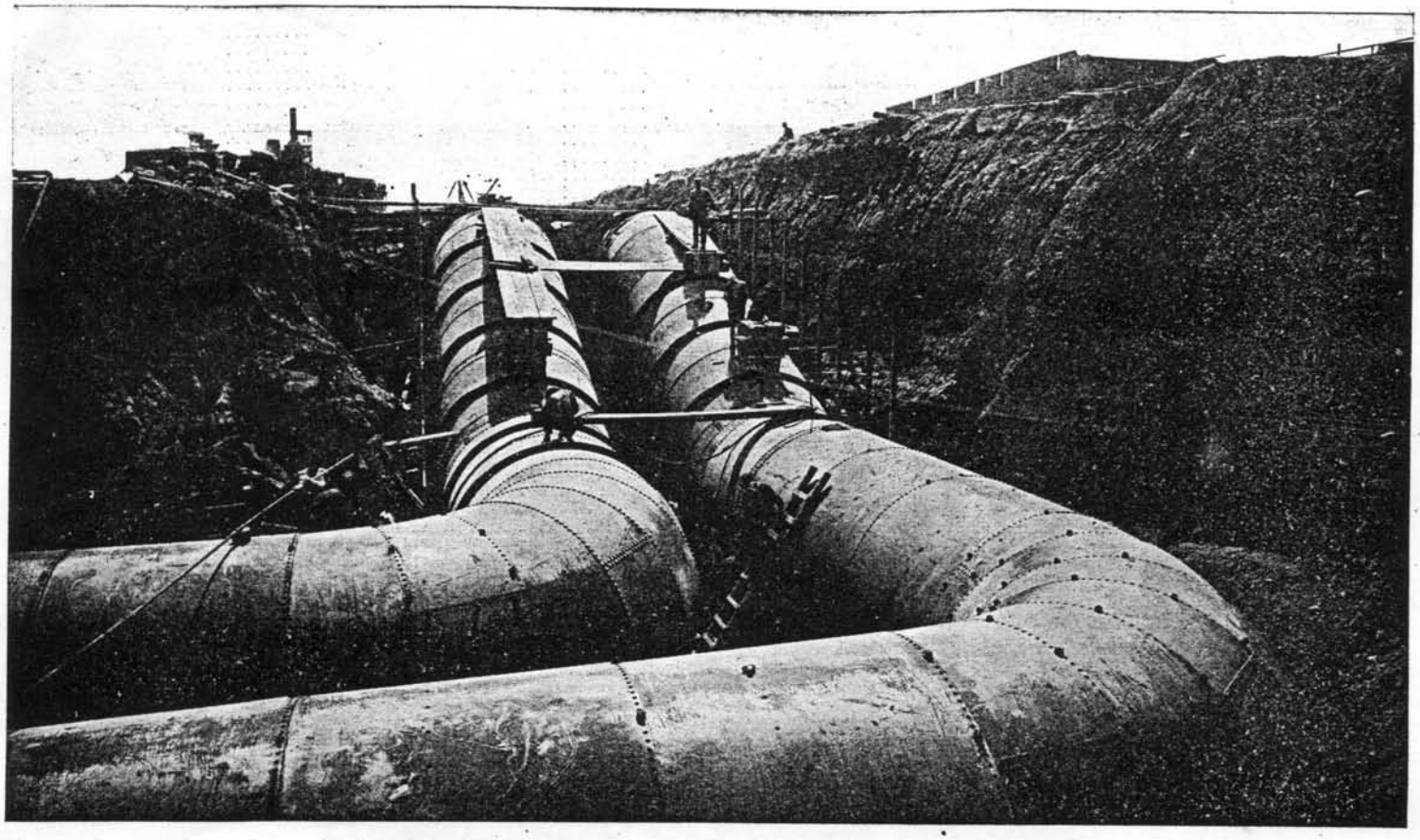
Philadelphia's Water Supply System

e by

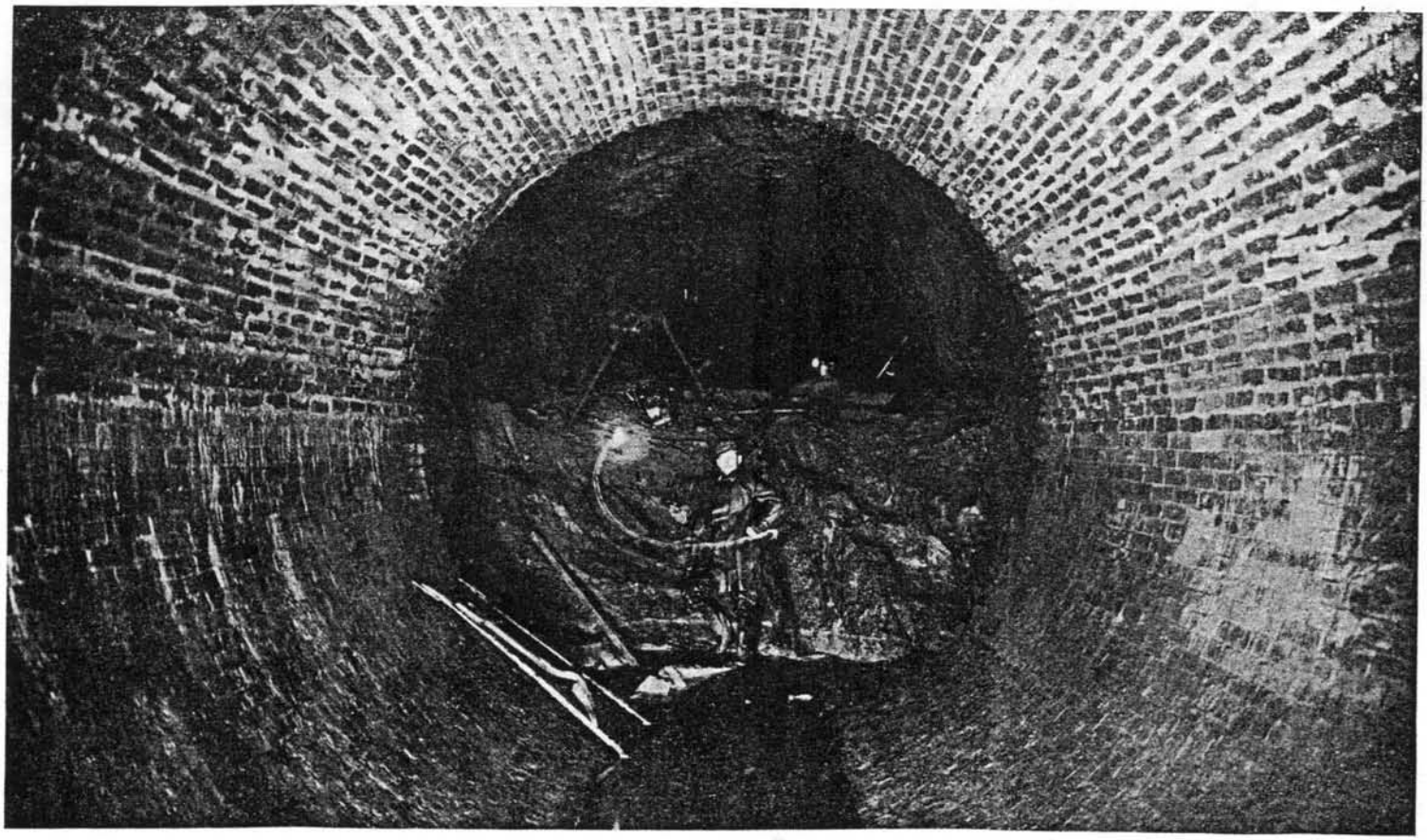
Size in inches.	No. of feet
1 inch pipe	175
1½ inch pipe	3,566
2 inch pipe	3,655
3 inch pipe	77,379
4 inch pipe	160,007
6 inch pipe	5,821,558
8 inch pipe	412,108
10 inch pipe	541,605
12 inch pipe	540,413
16 inch pipe	197,947
18 inch pipe	16,044
20 inch pipe	281,805
22 inch pipe	
23 inch pipe	No. of feet
24 inch pipe	1,084
30 inch pipe	27
36 inch pipe	20,613
48 inch pipe	298,380
60 inch pipe	102,068
	210,245
Total number of feet i use	9,500
Number of miles n	8,698,179
	1,650

Fire Hydrants by Wards

Wards	Total
First	277
Second	240
Third	135
Fourth	119
Fifth	218
Sixth	233
Seventh	242
Eighth	273
Ninth	276
Tenth	225
Eleventh	111
Twelfth	102
Thirteenth	164
Fourteenth	200
Fifteenth	466
Sixteenth	128
Seventeenth	163
Eighteenth	293
Nineteenth	688
Twentieth	313
Twenty-first	541
Twenty-second	1,506
Twenty-third	501
Twenty-fourth	519
Twenty-fifth	375
Twenty-sixth	
Twenty-seventh	Total
Twenty-eighth	375
Twenty-ninth	271
Thirtieth	337
Thirty-first	229
Thirty-second	251
Thirty-third	332
Thirty-fourth	261
Thirty-fifth	705
Thirty-sixth	503
Thirty-seventh	219
Thirty-eighth	511
Thirty-ninth	217
Fortieth	658
Forty-first	356
Forty-second	433
Forty-third	82
Forty-fourth	353
Forty-fifth	449
Forty-sixth	325
Forty-seventh	425
	464
Total	224
	16,288

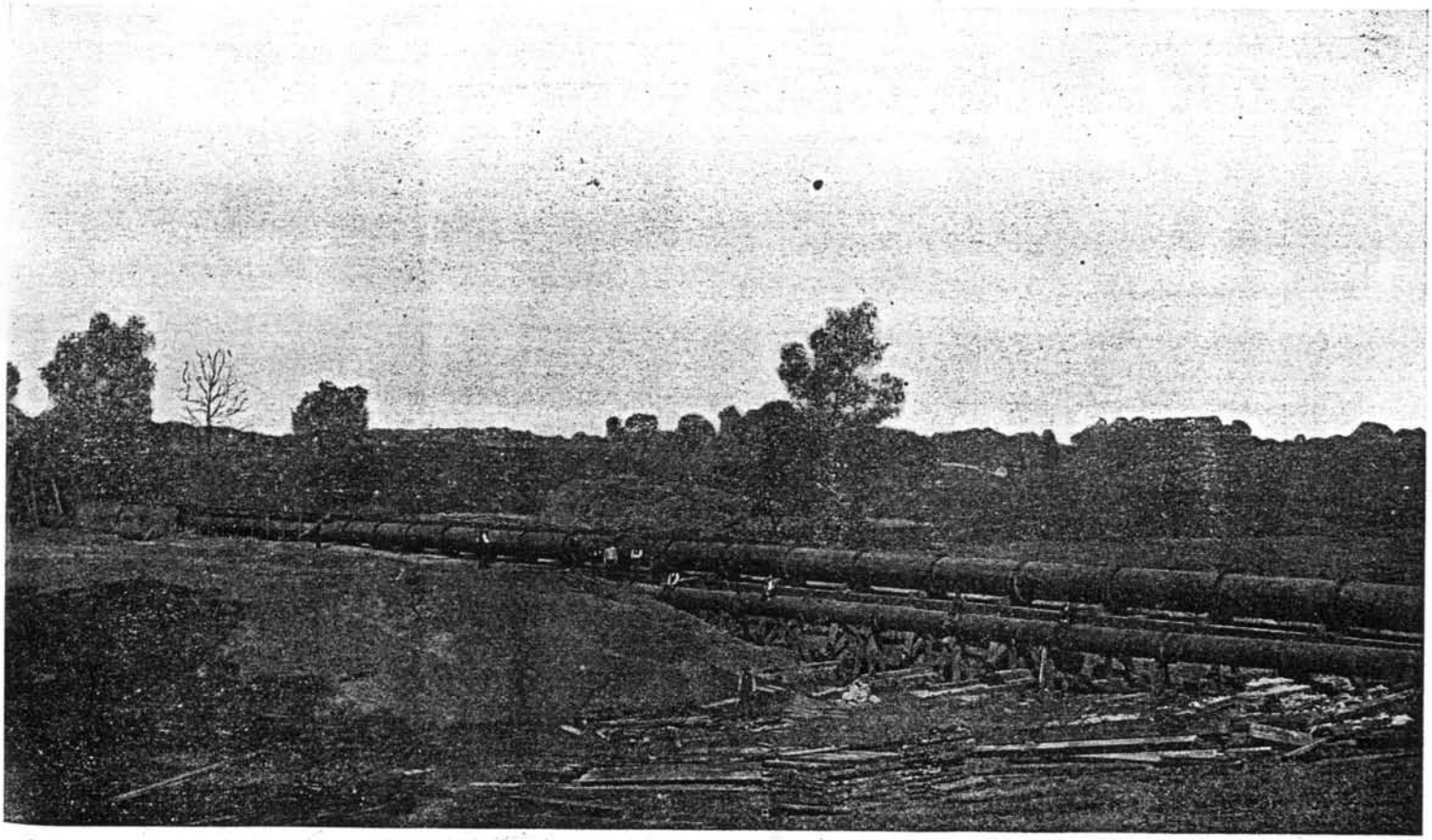


DOUBLE LINE OF GIANT PIPES, hill-climbing from Torresdale Filter Plant, carrying water to Lardner's Point Pumping Station; these pipes are eleven feet in diameter.

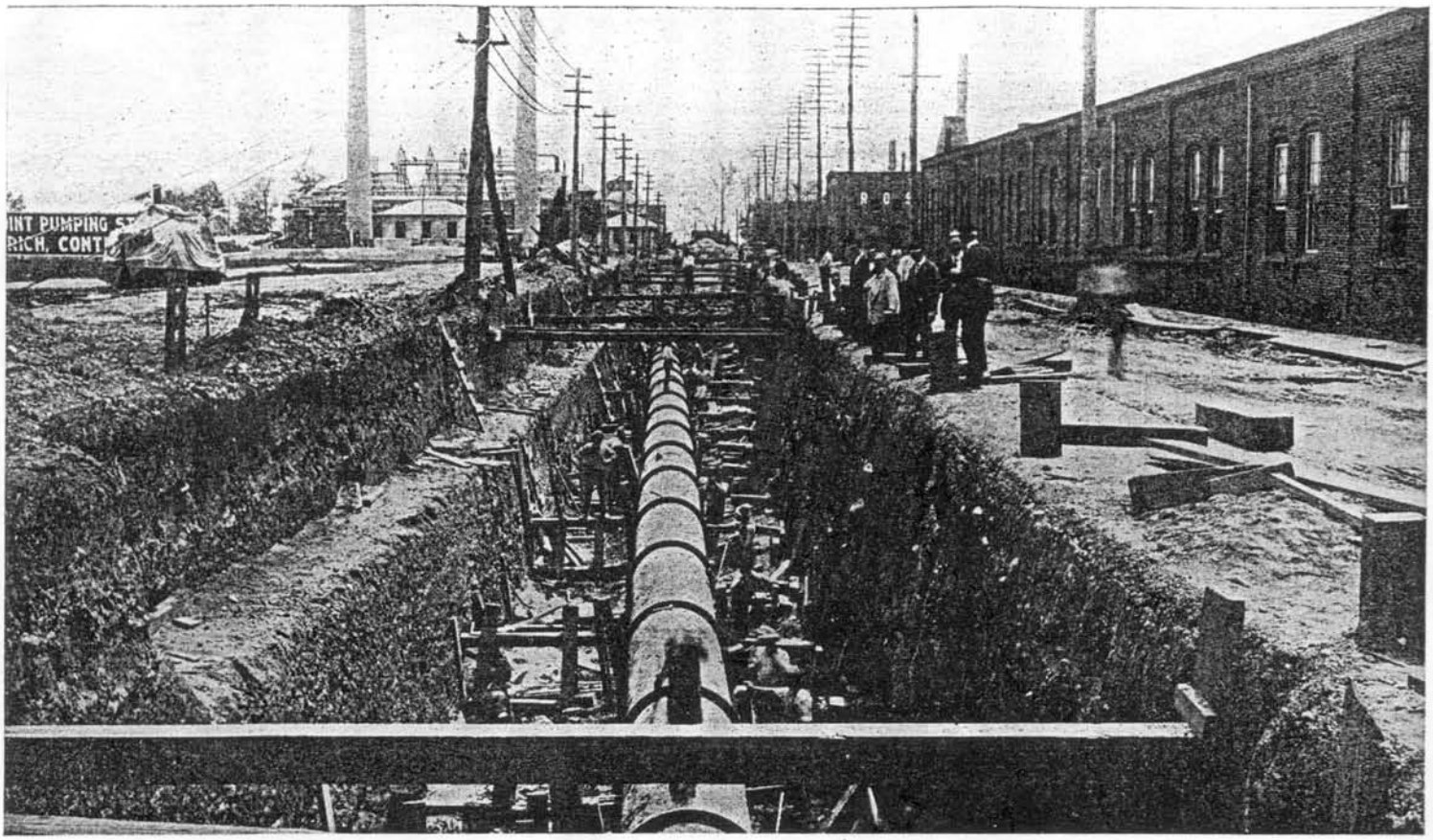


BRICK WORK OF TORRESDALE CONDUIT, ten feet seven inches in diameter. This conduit is laid at an average of 120 feet below ground surface; it is 13,809 feet in length, and is equivalent to a full-size railway tunnel 1½ miles long. One day's flow of water through this conduit equals enough water to fill 38,000 miles of six-inch pipe—the type of pipe most largely used for general delivery of water in Philadelphia.

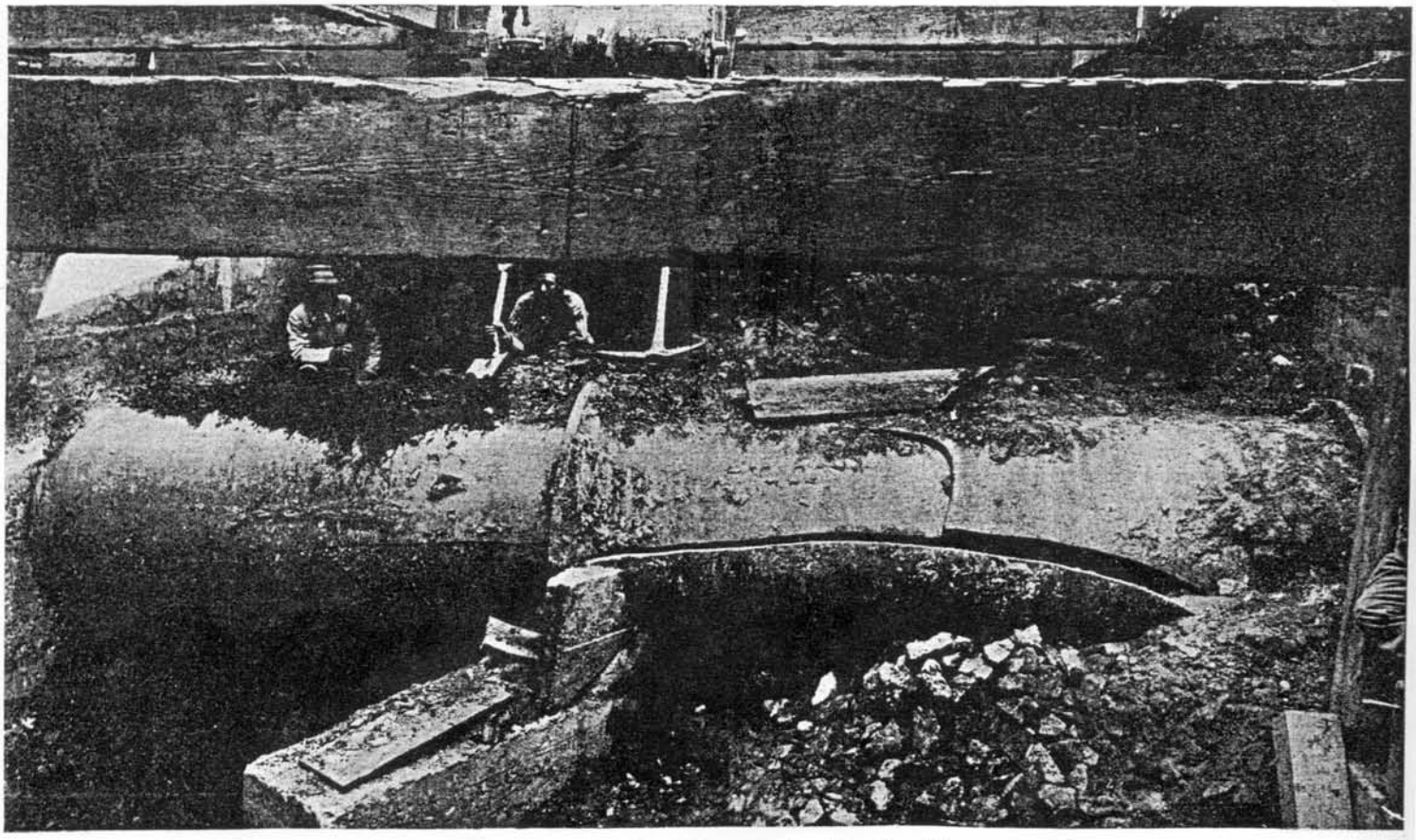
DIFFICULT WORK OF LOWERING 1,200 FEET OF THIRTY-INCH PIPE a distance of twenty feet. This work was made necessary to allow grade of new Northeast Boulevard to pass above existing water mains.



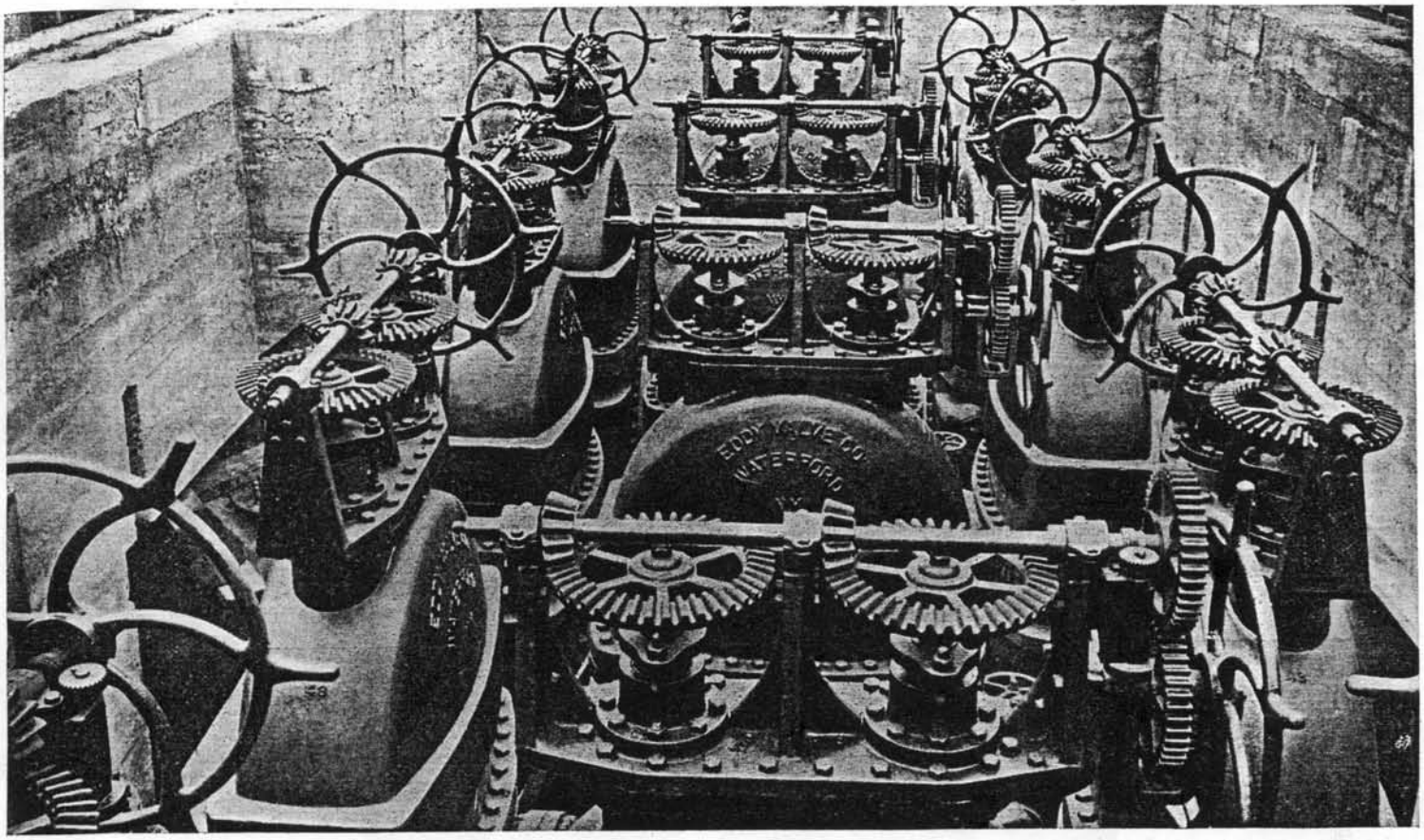
EASTERN END OF THE SAME THIRTY-INCH WATER MAIN, which has been lowered twenty-eight feet—a line of forty-eight-inch main is also shown uncovered.



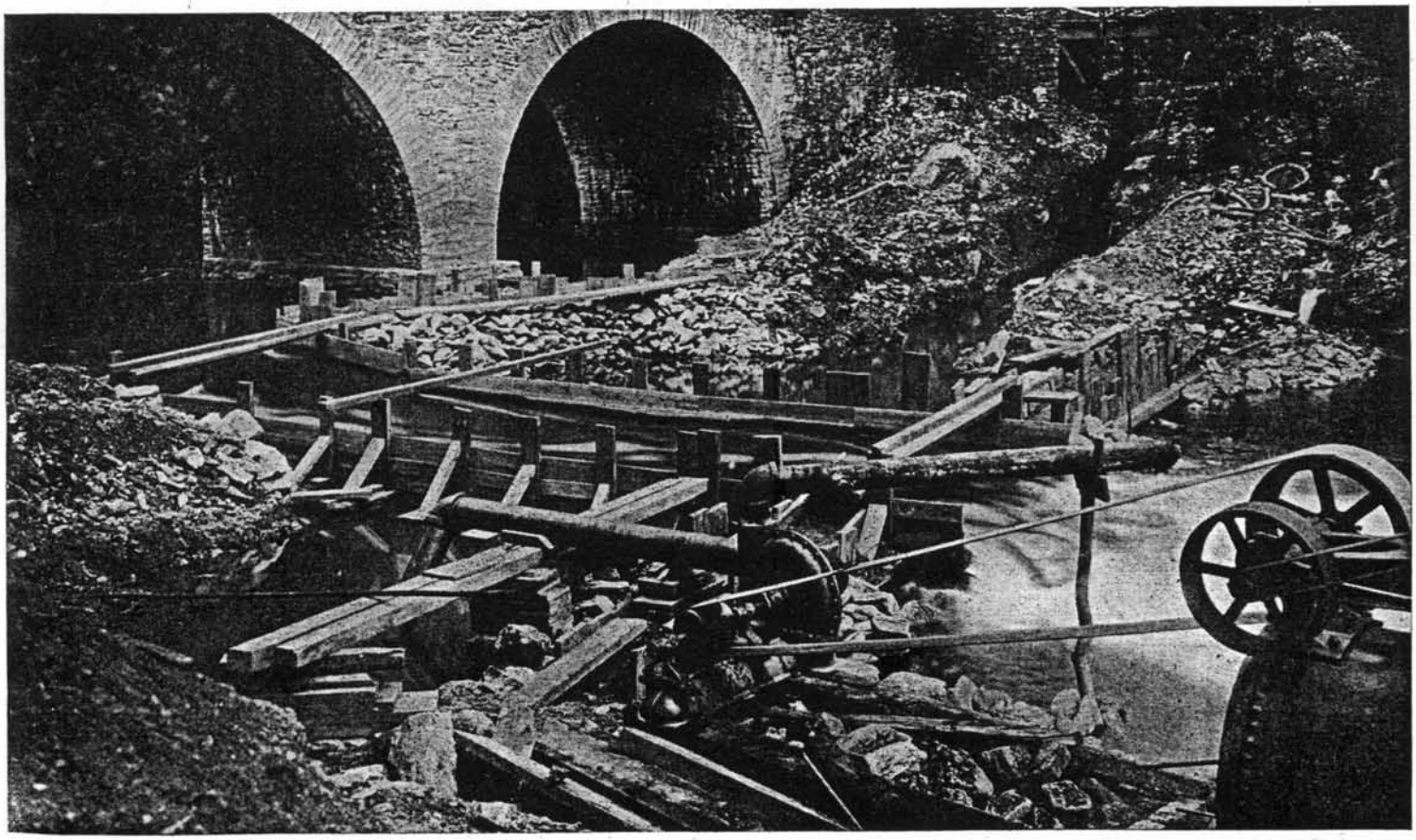
RELOCATION OF FORTY-EIGHT-INCH WATER MAIN to make room for additional mains. This is the most difficult feat ever performed by the Department, because pumping was never suspended through these mains, although the mains were lowered ten feet and deflected fourteen feet in a distance of 1,200 feet.



BREAK IN FORTY-EIGHT-INCH PIPE—One of the difficulties encountered in the daily water service of a great city.

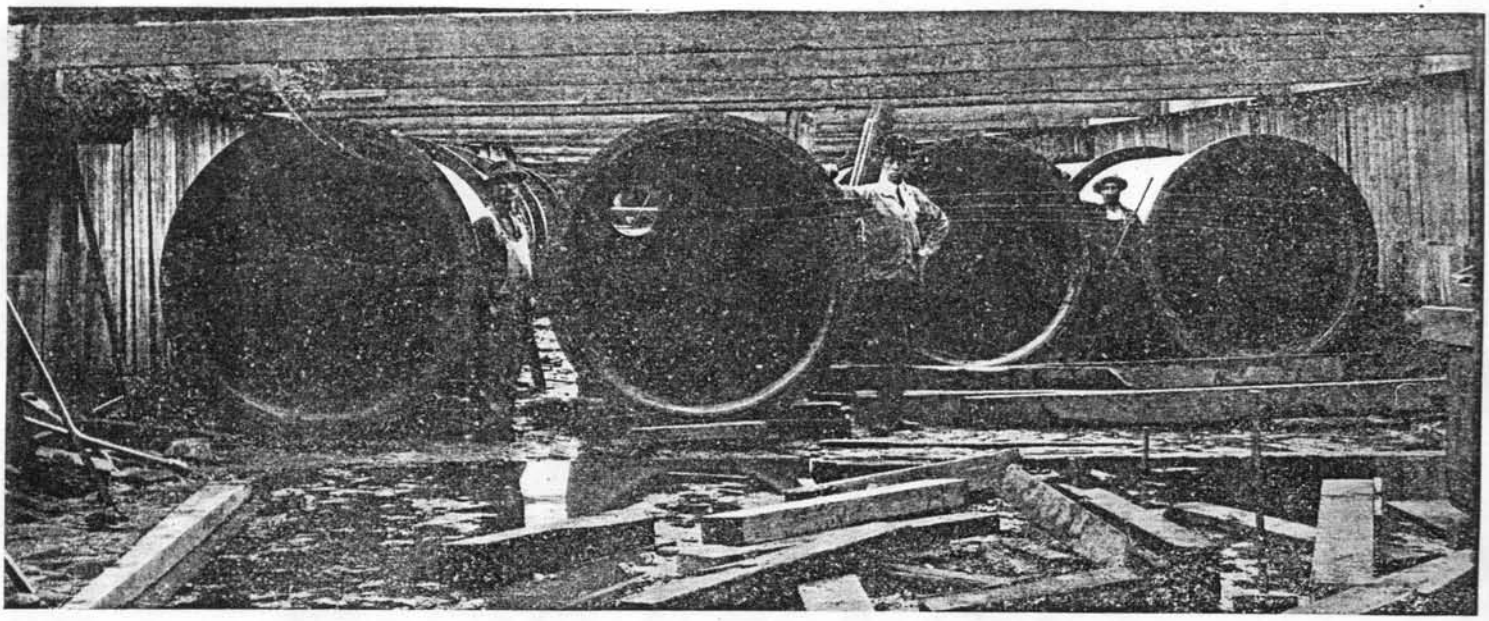


VALVE CHAMBER ON A LARGE LINE OF WATER MAINS, so arranged that a main can be put out of action for repairs without disturbing general water service.



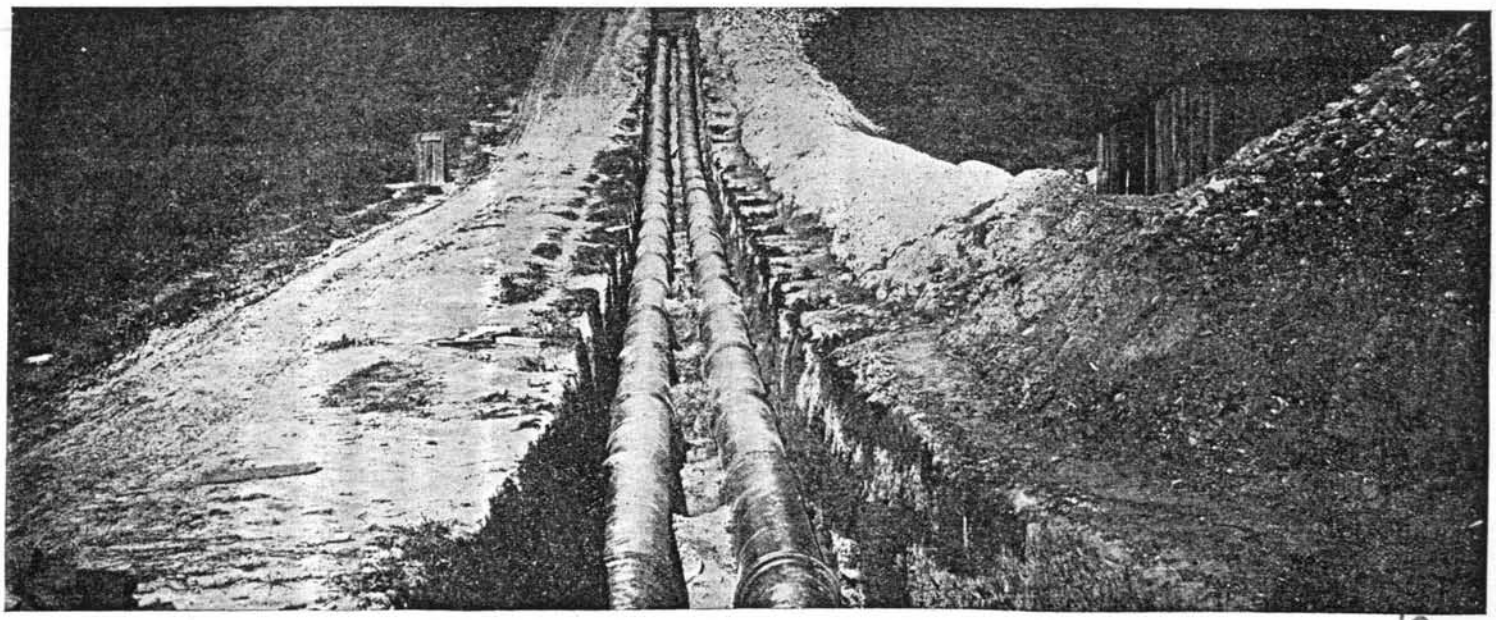
DIFFICULT WORK OF LAYING THIRTY-INCH PIPE across bed of Wissahickon creek—water flowing down a natural channel, fighting effort to convey other water in an artificial channel.

11



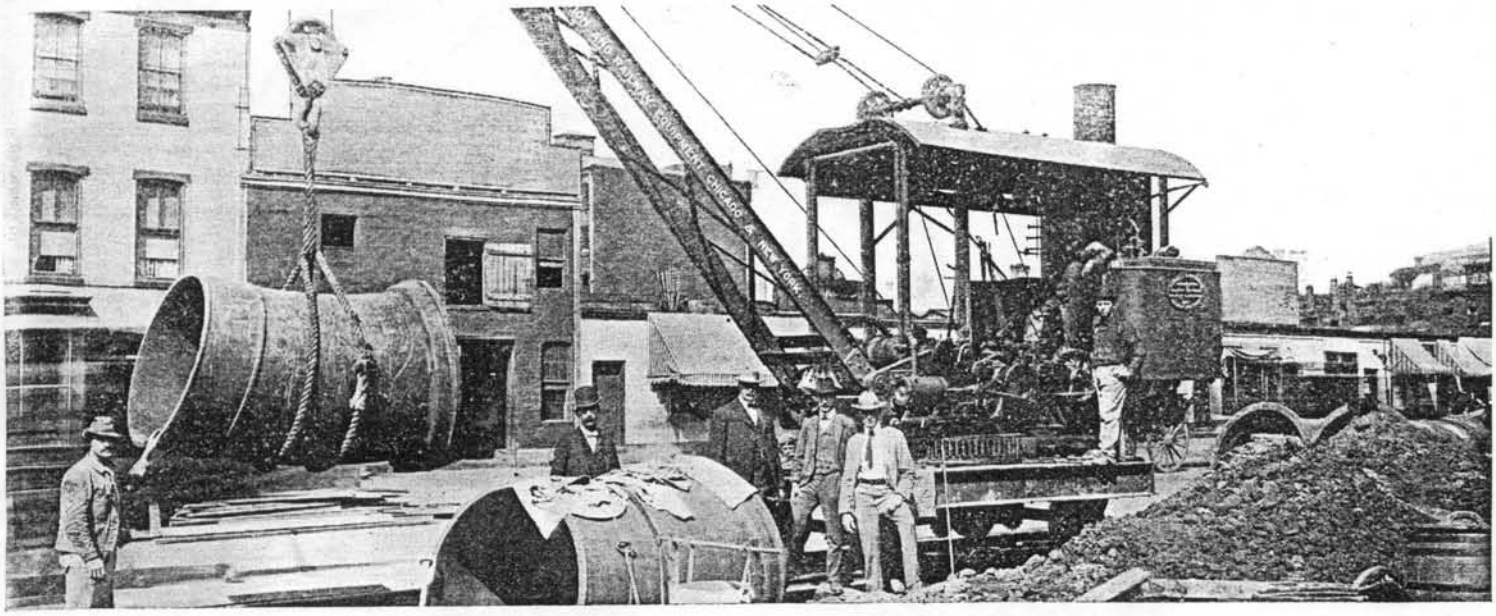
CLOSE VIEW OF FOUR GIANT SIXTY-INCH CAST IRON WATER MAINS in Robin street, showing method of shoring trenches.

LAYING A FORTY-EIGHT-INCH WATER MAIN IN BROAD STREET, showing necessary disturbances of traffic.



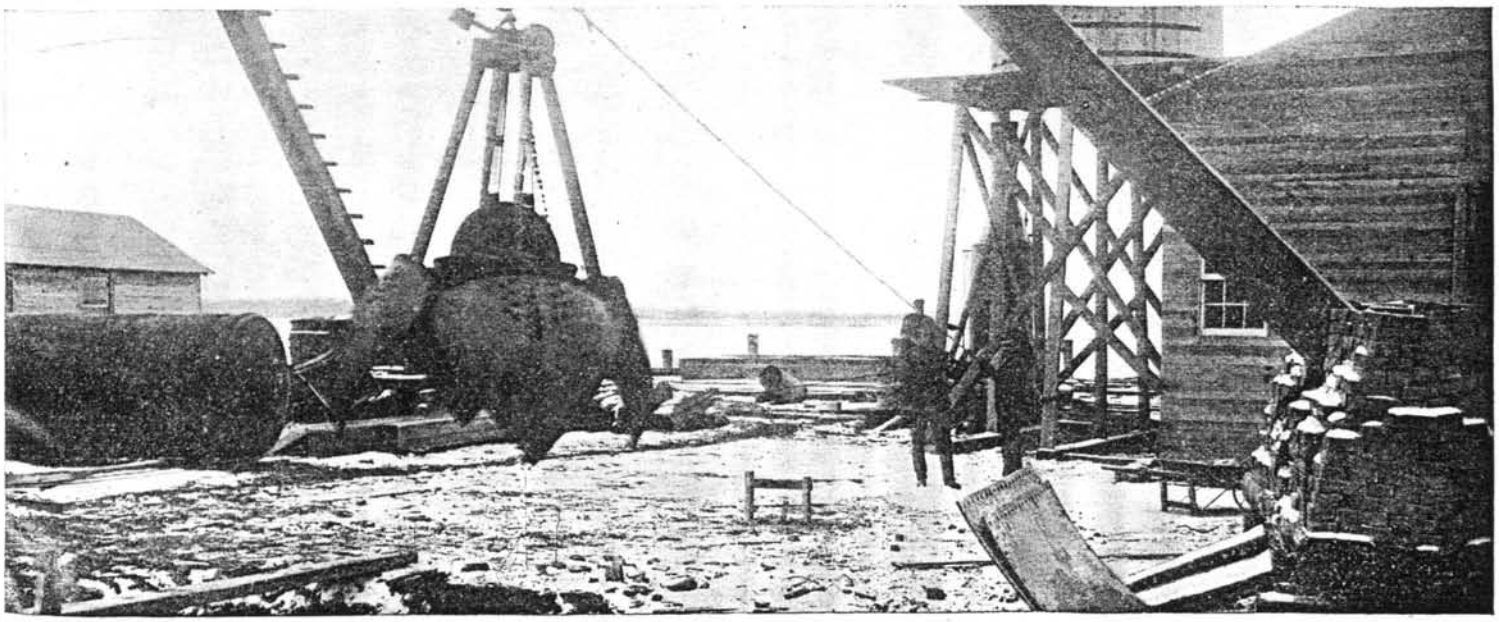
CARRYING THIRTY-INCH WATER MAINS through rolling country in the Roxborough District.

12



LOCOMOTIVE CRANE AT WORK, HANDLING A GREAT FORTY-EIGHT-INCH PIPE.

PRELIMINARY WORK IN PIPE LAYING, removing asphalt surface and starting trench.



GIANT ORANGE PEEL DIGGER IN ACTION AT SHAFT NO. 8, TORRESDALE CONDUIT.