

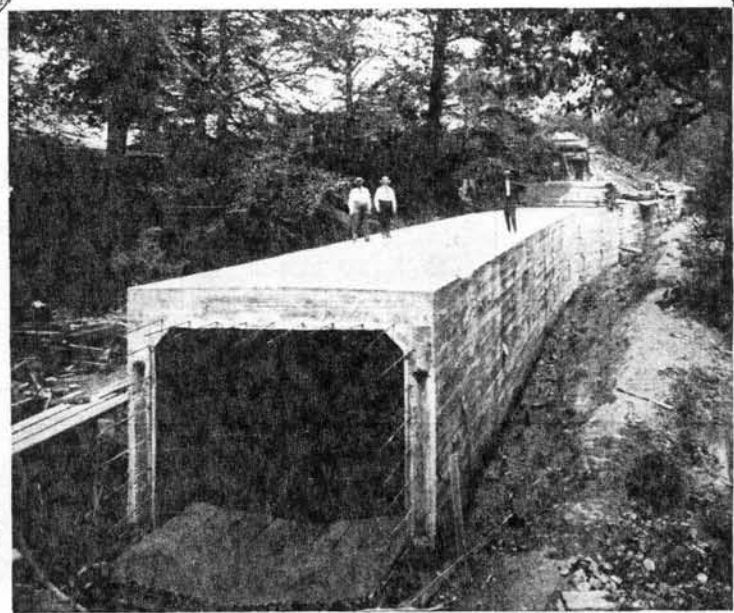
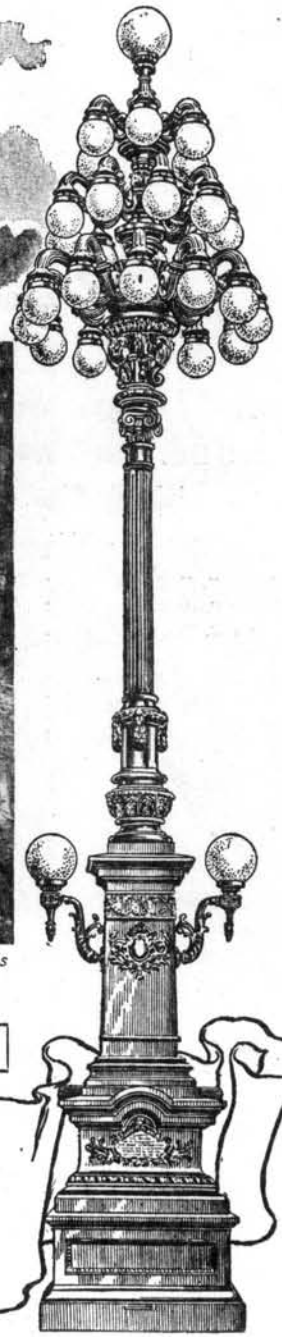
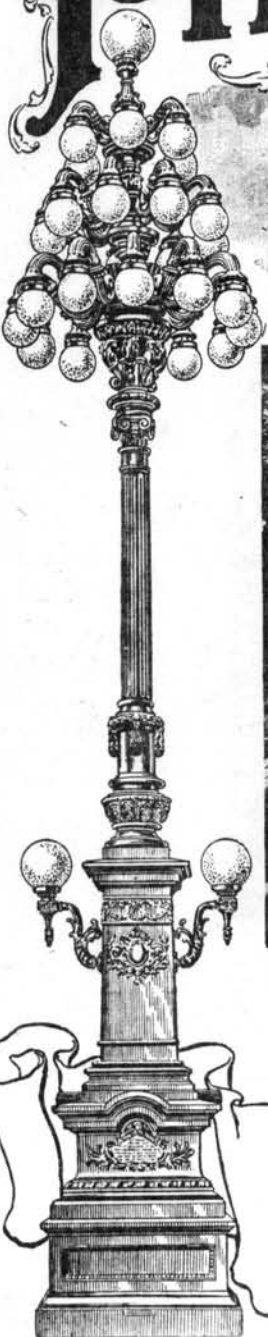


This material is part of the collection of the
Philadelphia Water Department
and was downloaded from the website
www.phillyh2o.org

Please contact the PhillyH2O webmaster
for more information about this material.

2004.059.0421

PHILADELPHIA



Type of rectangular reinforced concrete sewer, 13 feet x 11 feet. Philadelphia's sewerage system is 1,226 miles in length, or equal to distance from Philadelphia to New Orleans, it cost 57 million dollars

VOLUME IV JUNE, 1911 NUMBER 6

PUBLISHED BY THE
CITY GOVERNMENT

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 *Budget 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*. The present number is devoted to *Underground Philadelphia, Main and Branch Sewers*. "Philadelphia" may be obtained from George W. B. Hicks, Editor, Bureau of Contracts and Statistics, Rooms 203-205, City Hall, Philadelphia.

UNDERGROUND PHILADELPHIA

No. 1.—MAIN AND BRANCH SEWERS

At the very first step in any study of underground Philadelphia the far-reaching influence of two facts conspicuous in present-day conditions must be clearly and fully recognized: first, the steadily increasing sweep of population from the country to the city, a movement born of the wider knowledge disseminated by an unfettered and well financed press of the conditions in which life is lived to-day by all classes all over the world, bringing to a large body of the world's population discontent with that slow moving, uneventful life in which they had heretofore been ignorantly happy; second, the higher standard of living demanded by people resident in cities as an inevitable sequence of this deeper and wider knowledge regarding features in physical environment which make for the robust health and the real happiness of a people.

The direct influence upon the activities and expenses of municipal administration of either one of these two world-working influences would have been tremendous during the past decade, for with increase in population in cities there must of necessity have developed increased demand for facilities of civilization normally associated with life in cities. On the other hand, even had population shown merely a normal increase in cities, an advancing standard of public aids to health and the increase of happiness would have placed upon the municipality the burden of a largely increased expenditure to keep pace with advancing ideals. But when it is realized that both great influences described, each making for increased expenditure and increased administrative activity, have reached their maximum influence coincidentally, it becomes apparent even to the most superficial student that a situation has developed which challenges the best ability of the world to the solving of great municipal problems.

In the old Mother City of Philadelphia these two world influences have not been sufficiently recognized by all the people, neither have they been fully appreciated, by a considerable portion of the population resident throughout the Republic. For many people, both in and out of Philadelphia, have come to regard Philadelphia chiefly as a City with a past—a City outside of or beyond the influence of those irresistible sur-

rents of public sentiment which are affecting all centers of population, classed by clear-seeing students as vital factors in the wonderful development marking these opening years of the twentieth century. For so much has been spoken and written of Philadelphia's glorious past, such a large majority of visitors to Philadelphia have come to the City of the Declaration and the Constitution for the sole purpose of visiting points of historic interest, that even a considerable section of Philadelphia's own population has forgotten that Philadelphia renewed her youth with the Centennial Exposition of 1876; forgotten, also, that the City, in every line of municipal activity, is well abreast with the most advanced cities in the world, and therefore in a position to feel, and feel strongly, any world movement bearing upon old practices in municipal administration. Indeed, owing to certain peculiar features in her physical characteristics, Philadelphia has come more directly under the influence of these new world influences than any other American city: first, because the influences have had to do with the increase of comfort in home life, and Philadelphia with her 341,000 homes is the greatest home center in the world; second, they have represented an immense increase in City population, and Philadelphia has built more housing accommodations for new population in the past thirty-five years than in the preceding one hundred and eighty years. Moreover, a certain important and valuable body of traditions and ideals, inherited from the founder, William Penn, touching the rights of the individual, has been responsible for a body of sentiment opposing all radical change, such sentiment having been strong enough to make the task of carrying out such changes a problem of the first rank to all administrative officials. In studying the effect upon City administration, therefore, of any new influence upon administrative lines of action, Philadelphia offers opportunity to study such a problem under the most favorable circumstance, because here the new order of procedure must meet with as strong an opposition as in any other city, while the rapid development of the City and its wonderful activities in all forms of municipal life make the problem, in every sense of

the word, a problem affecting real life in a real city.

Passing from the general to the particular, the new world movements of city concentrating population, and higher ideals regarding home comforts, have worked to increase the importance of such problems as may be classed under the general title of Underground Philadelphia, this subject covering the City's sewerage system, its system of water mains and connections, and its system of underground wires, gas mains and subways. In this paper investigation is limited to the subject of Philadelphia's sewerage system, or the problem represented by Philadelphia's 1,226 miles of sewers, ranging from 12 inches to 20 feet in diameter, operating in an area of 129½ square miles, giving direct connection to 248,637 separate buildings, and representing an expenditure by the City of \$25,000,000, of a gross investment, including separate building connections, in the main paid for by owners and occupiers, of \$57,000,000. This study of Philadelphia's sewerage system is of special importance at the present time, because, under a ruling of the State Department of Health, interpreting an Act "to preserve the purity of the waters of the State for the protection of the public health," approved April 22, 1905, the City of Philadelphia must submit to the State authorities before January 1, 1912, a complete plan whereby all Philadelphia sewage can be disposed of without deposit in waters of the State. The State's interpretation of the Act in question has forced the City to secure from the State Department of Health permission to lay every new sewer and, as a consequence, sewer development in Philadelphia has of late years shown the remarkable condition of a great city yielding the sewage for one and a half million people under a system which the State has declared must be changed at a given date, while her engineers are rapidly developing plans for a new system, coincidentally building additions to the existing, or old system, able to serve present needs and yet conform to the new requirements regarding disposal of product.

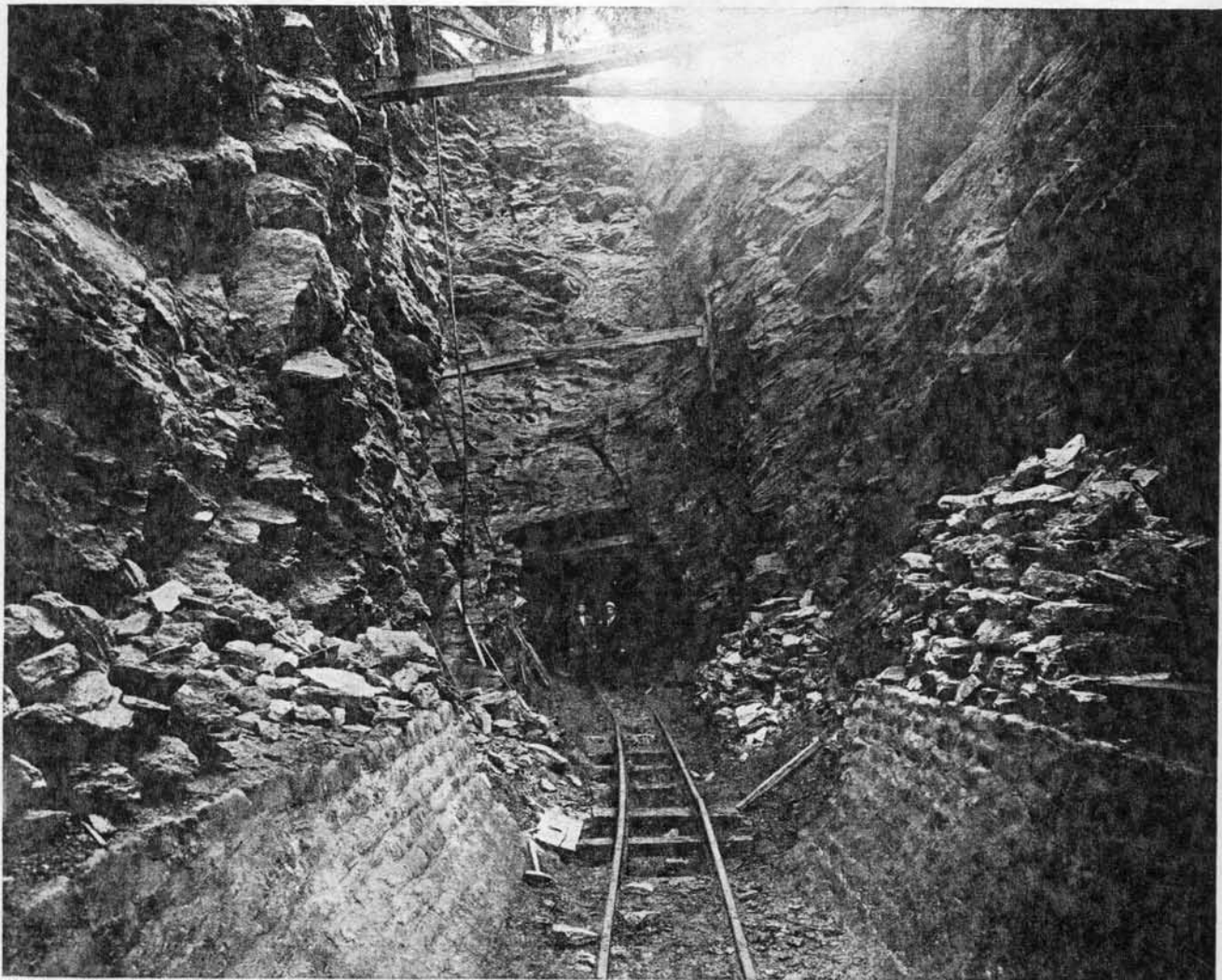
While all municipal problems of the first rank must be regarded primarily as affecting the health and happiness of the people,

of almost equal importance is the question, whether the solving of such problems places a burden upon municipal finances, or acts as an aid in producing new revenue. The economic side, therefore, of this sewer provision question forces immediate attention in any thorough study of the part which the building and maintaining of sewers plays in the government of a great city.

This study of the power of sewer construction to increase City revenue, and, incidentally, through increased revenue, increase the prosperity of the whole City, may

ing in taxes each year, even if assessed at full value and paying the highest City rate of $1\frac{1}{2}$ per cent., \$150. The City's borrowing capacity on this land in its unimproved state would be only \$700, or 7 per cent. Now imagine this same body of land converted into a suitable site for houses through construction of sewers, opening of streets, laying of water and gas mains, what would be the result? This acre of land would carry 33 dwellings assessed at about \$3,000, or, in round figures, \$100,000 in place of the original assessment of \$10,000, the improved property paying annual taxes of \$1,500 a

figures, \$100,000 of value; the result would be as follows:—In its undeveloped condition the tract in question paid in taxes at the suburban rate of 1 per cent., \$10, and the City's borrowing capacity on this body of land at 7 per cent. was \$70. When the land in question carried its 33 homes, the tax received from the property, even at the same suburban rate of taxation, namely \$1 a hundred, or 1 per cent., would amount to \$1,000, the City's borrowing capacity being increased from \$70 to \$7,000. If the property were taxed at the full City rate of $1\frac{1}{2}$ per cent., the increase in revenue to the



DIFFICULT AND EXPENSIVE ROCK WORK ON WISSAHICKON HIGH LEVEL CUT-OFF. This sewer is six feet in diameter and about four miles in length, and lies from 40 to 150 feet below the surface. It will serve the higher elevations along the Wissahickon Creek. When completed it will be four miles in length, and cost the City \$750,000.

be illustrated by taking an average land development in the undeveloped section of the City. A block of land bounded by four main streets, sixty feet in width, cut in one direction by two forty-foot streets and containing 5 1-3 acres would provide sites for 168 low-priced homes, the typical six and seven room house, with bath and modern plumbing, selling for about \$3,000, and typical of the average home occupied by the skilled worker of to-day. This land prior to occupation for building purposes, even in some of the best residential wards, would not command more than \$10,000 an acre, pay-

year in contrast with the old payment of \$150, the borrowing capacity of the City on such property being \$7,000 a year in contrast with \$700. Take for a further and more favorable illustration a parcel of land in some outlying wards, and the problem would work out as follows: The average assessment for the whole ward is \$470 an acre; now, assume the land taken for building purposes to be worth double this average, or \$1,000 an acre, and bring about the same development as that supposed to have taken place on the high priced land producing 33 homes, assessed at \$3,000, or, in round

City growing out of the improvement would be represented by an increase in tax payments from \$10 to \$1,500. Let us go a step farther and suppose, for illustration, that only one-quarter of the territory in this large but sparsely settled ward should, as a result of good sewage and the provision of transportation, develop into a residential section similar to that already explained, the improvement of this one-quarter acreage of one of the City's 47 wards would increase the City's revenue from taxes from \$60,000 a year to \$9,000,000, the City's borrowing capacity being increased from \$420,000 to

\$42,000,000. These figures stagger by their immensity and illustrate the marvelous possibilities for development offered by the present unoccupied areas within City limits. They emphasize, also, the wonderful revenue producing power of certain facilities for comfortable living, such, for example, as the picturesque sewer, often held in light esteem by the superficial student of economic problems. For the great majority of such students fail to recognize the great truth that no substantial building development can take place at the present day without being preceded by the creation of sewer service with its attendant water service. Consequently, the cornerstone for City building is practically represented by the creation of a system of main and branch sewers. Indeed,

borrowing capacity for production of funds to be used in general improvement, but it helps to conserve and to increase the City's natural earning capacity through the continuous employment at maximum powers of its citizenship. Under-ground Philadelphia, therefore, as typified in the City's sewage system, holds tremendous power to make or mar the life work of every individual in the community, and its systematic and generous development has established a first claim upon the highest skill and largest resources of the City's government. In a word, the sewer—an object of little regard by all citizens, a subject unattractive in the extreme to many—may be truthfully called the path-finder for the greatest City of Homes, reaching into outlying districts and draw-

twenty-eight outlying districts into the present day Philadelphia became effective 56 years ago, the City had in operation only 36 miles of main and branch sewers. The population at this time was about one-third of present day population, and on this basis there should be to-day in operation only 108 miles of sewers, whereas there are now in operation 1,226 miles. To-day, therefore, the per capita sewage provision is 11 1-3 times greater than when Philadelphia consolidated in 1854, although the City at that date had to its credit 171 years of incorporated existence.

Broadly speaking, the City of Philadelphia is served by the following systems of sewers: West Philadelphia: First, Mill Creek sewer, 20 feet in diameter, which



PWD ID: 2004.032.0128

MILL CREEK SEWER. This great sewer is eight miles in length. When first built it extended a mile before reaching any built-up section. Building operations followed so rapidly upon its completion that increase in values within a period of two years returned to the City, in taxes, more than the total cost of the whole sewer. The diameter of the sewer is 20 feet, being the largest in the City of Philadelphia.

it can be truthfully said that sewer construction is the first step and the longest step in the journey from a small town to a large city. For not only does the construction of the sewer bring into the area of availability, at wonderfully increased rates of taxation, areas heretofore producing but small revenue to the City or to the owners of the property, but, through this land development, due to sewage provision, overcrowding is prevented, the public health is improved, and the tremendous loss to the community as a whole through loss of laboring capacity by the individual as an incident of ill health is largely avoided. The sewer, therefore, not only creates a new expression of wealth, susceptible of producing revenue to the City and increasing the City's

ing, through its beneficent influence, into the area of home occupation, tracts of land of little value to present-day owners, because useless as sites for healthy homes for a happy and contented people.

Coming a little closer to the subject, Philadelphia's sewers to-day have a total length of 1,226 miles, a length sufficient, if placed end on end, to reach from Philadelphia to New Orleans. During the life of the present administration, or in the years 1907-8-9-10, 137 miles, or 11¼ per cent., of this whole system has been constructed, this work representing 1,004 separate pieces of sewer construction, or an average of nearly one piece of sewer work completed for every working day during the past four years. When the consolidation of the

empties into the Schuylkill at Forty-fifth street, extending northwest to City line at Overbrook, serving an area of 4,310 acres; second, Thomas Run sewer, emptying into Cobb's creek at Florence avenue, extending north to Fifty-sixth and Arch, serving area 1,100 acres; third, Charles creek sewer, mouth at Sixty-seventh street, west to Sixty-fifth and Woodland avenue.

South Philadelphia: First, Passyunk avenue system, which runs from its mouth, Schuylkill river, out Passyunk avenue to Sixteenth and Wharton, serving area of 805 acres; second, Oregon sewer, mouth in Delaware river at Oregon avenue, runs west to Broad street.

North and Central Philadelphia are served by four systems: First, Rock Run system,

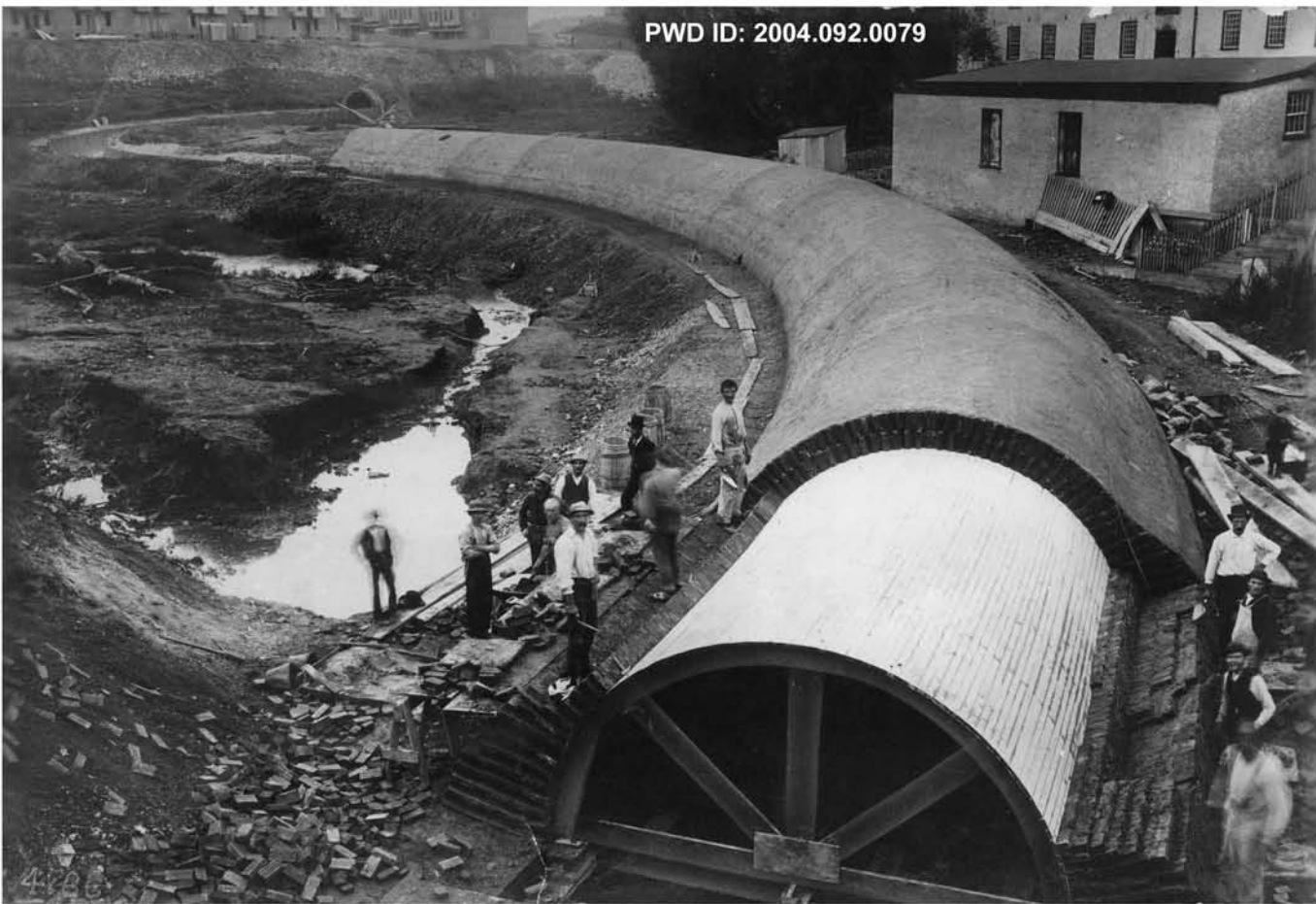
mouth in the Tacony creek, along the Boulevard, in a northwesterly direction to Oak Lane, serving a district of 1,724 acres; second, Wingohocking system, mouth in Tacony creek, out Wingohocking street northwest to Chestnut Hill, serving district of 5,475 acres; third, Gunner's Run system, mouth in the Delaware river, out Somerset street in a northwesterly direction to Tioga, serving a district of 2,420 acres; fourth, Cohocksink system, mouth in the Delaware river, out Camac street in northwesterly direction to Strawberry Mansion, serving 2,850 acres.

Northeast Philadelphia: First, the Frankford intercepting system from a point on Frankford creek out Wakeling street to Lawndale, serving a district of 2,560 acres;

passage of this Act has contained the following conditions: "The City of Philadelphia shall prepare and submit to the State Department of Health by January 1, 1912, a comprehensive plan for the collection, purification and disposal of sewage for the entire City, and that designs for the extension of existing system shall not be at cross purposes with this plan, and also that some progress shall be made during each year toward this end." As a preparatory step in this important work expert officials of the City inspected important modern sewage-disposal and purification plants in the United States and the principal cities of England, France and Germany. Coincidentally, the Engineering Department has obtained plans and data concerning the

refuse, individuals would, in the large majority of cases, wholly disregard the rights of neighbors. In fact, some of the most difficult police work has been enforcement, through the Department of Health, of certain necessary restrictions on the individual in connection with this very matter of trespassing upon the rights of his fellow-citizen. The same tendency to individual selfishness has found repeated manifestation in a larger degree in relations between towns and cities, one town emptying its refuse into a stream from which another drew supply of drinking water. Only within recent years has public sentiment reached a condition which enforced legislation safeguarding the rights of others—between individuals and between separate

PWD ID: 2004.092.0079



MILL CREEK SEWER after upper section was built. This sewer extends from its mouth in the Schuylkill at Forty-fifth street northwest to City Line at Overbrook, and serves an area of 4,310 acres.

second, Wissinoming system, from the Delaware river out Lardner street northwesterly, serving district of 1,217 acres.

Northwest Philadelphia has an intercepting system, serving Chestnut Hill, Germantown, Manayunk and Falls of Schuylkill, a district of 5,500 acres.

No study of Philadelphia's present day sewers and sewerage system would be complete without reference to the extensive experiments systematically carried on during the present administration with the object of developing a general plan of sewage disposal that would conform to the requirements of the Act of Assembly forbidding pollution of waters of the State. Every permit granted by the State Commissioner of Health to build a new sewer since the

amount of land required for the various methods used, comparative cost of construction and operation, capacities and efficiencies of plants operated and the influence of local conditions.

The whole question of sewage and sewage disposal in its modern development illustrates the growing recognition of man's responsibility to his fellow-man, and the more perfect co-operation between individuals and communities in all that goes to affect life, liberty and the pursuit of happiness. Nothing more clearly illustrates this changing point of view than recent legislation looking to the preservation of streams by forbidding use of streams as deposit points for sewage matter. Up to very recent times, even in the disposal of home

communities—and the conservation of all streams—has become the settled policy of nearly all States. While this water conservation policy has put upon all incorporated centers of population a heavy expense to provide means of sewage disposal, such an expenditure will be fully returned through increased health and a consequent increased earning capacity in the people so benefited, while in addition to all this that is material in its character and easily estimated in dollars and cents, there is to be taken into account the greater benefit certain to result from this public recognition by both individuals and communities of the necessity to consult the rights of others in all that makes provision for the day by day wants and requirements of twentieth century civilization.

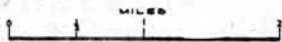
Section missing in middle
at fold

Section missing at top

DEPARTMENT OF PUBLIC WORKS
BUREAU OF SURVEYS

EXPLANATION

- PROPOSED MAIN SEWER EXTENSIONS
- MAIN SEWERS CONSTRUCTED AND UNDER CONTRACT
- STREETS OPENED
- - - STREETS UNOPENED
- PLUVIOMETER STATION
- STREAM GAUGE STATION



Section missing in middle
at fold

DELAWARE

6



The City of Philadelphia is served by the following Systems of Sewers

In West Philadelphia, first, by the Mill Creek sewer, 20 feet in diameter, which empties into the Schuylkill at Forty-fifth street, extending in a northwesterly direction to the City line at Overbrook, directly serving an area of 4,310 acres. Second, by the Thomas Run sewer, emptying into Cobb's creek at Florence avenue and extending north to Fifty-sixth and Arch, directly serving an area of 1,100 acres. Third, Charles creek sewer, which, from its mouth at Sixty-seventh street, runs west to Sixty-fifth and Woodland avenue, this system being farthest south of any system west of the Schuylkill river.

South Philadelphia is served, first, by the Passyunk avenue system, which runs from its mouth, Schuylkill river, out Passyunk avenue east and north to Sixteenth and Wharton, serving an area of 805 acres. This system is the most southerly one west of Broad street. Second, Oregon sewer, which from its mouth the Delaware river at Oregon avenue, runs west to Broad street, and at present serves 55 acres, being the farthest system east of Broad street in South Philadelphia.

North and Central Philadelphia are served by four systems: First, Rock Run system,

extending, from its mouth in the Tacony creek, along the Boulevard in a northwesterly direction to Cak Lane, serving a district of 1,724 acres. Second, Wingohocking system, extending from its mouth in Tacony creek, out Wingohocking street northwest to Chestnut Hill, and serving a district of 5,475 acres. Third, Gunner's Run system, extending from its mouth in the Delaware river out Somerset street in a northwesterly direction to Tioga, serving a district of 2,420 acres. Fourth, Cohocksink system, extending from its mouth in the Delaware river out Camac street in a northwesterly direction to Strawberry Mansion, serving 2,850 acres, including Norris street outlet.

Northeast Philadelphia is served by two systems: First, the Frankford intercepting system from a point on Frankford creek out Wakeling street to Lawndale, serving a district of 2,560 acres. Second, Wissinoming system, from the Delaware river out Lardner street northwesterly, giving service to a district of 1,217 acres.

Northwest Philadelphia has the service of an intercepting system: Chestnut Hill, Germantown, Manayunk and Falls of Schuylkill, a district of 5,500 acres.



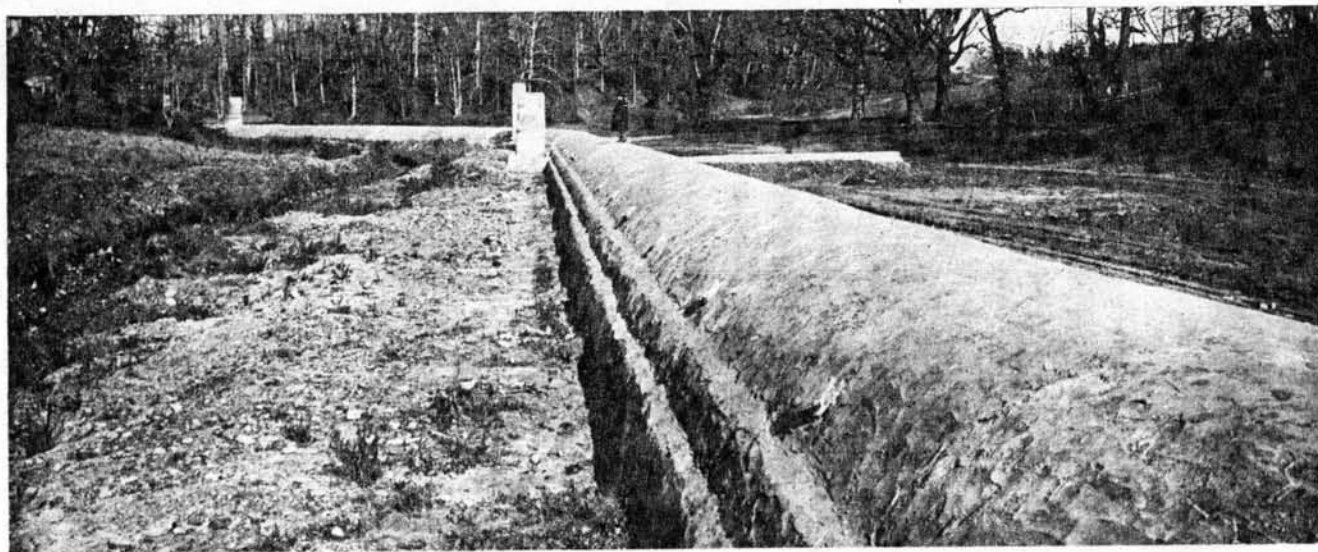


SHAWMONT INTERCEPTING SEWER, about three-fourths of a mile in length, serving Roxborough Filter Beds and environs, intercepting sewage from the Schuylkill River.

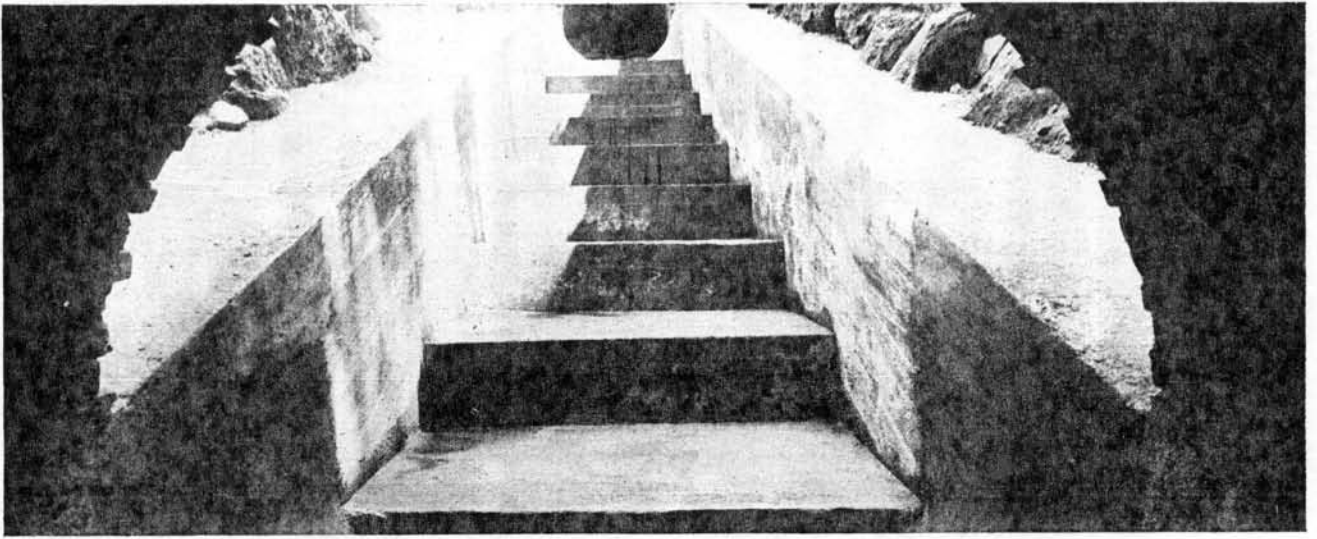


PWD ID: 2004.033.0229

WINGOHOCKING SEWER SYSTEM on Annsbury Street; 14.8 miles in length; when completed it will be 16.11 miles in length; built of brick; diameter 17 feet 6 inches; will be 20 feet in diameter at outlet into Frankford Creek when completed. This sewer system serves one of the most important sections of the City, emptying into the Frankford Creek at Wingohocking Street and carrying sewage for the northwestern district as far as Chestnut Hill, altogether serving a district of 5,500 acres, largest drainage area in City.



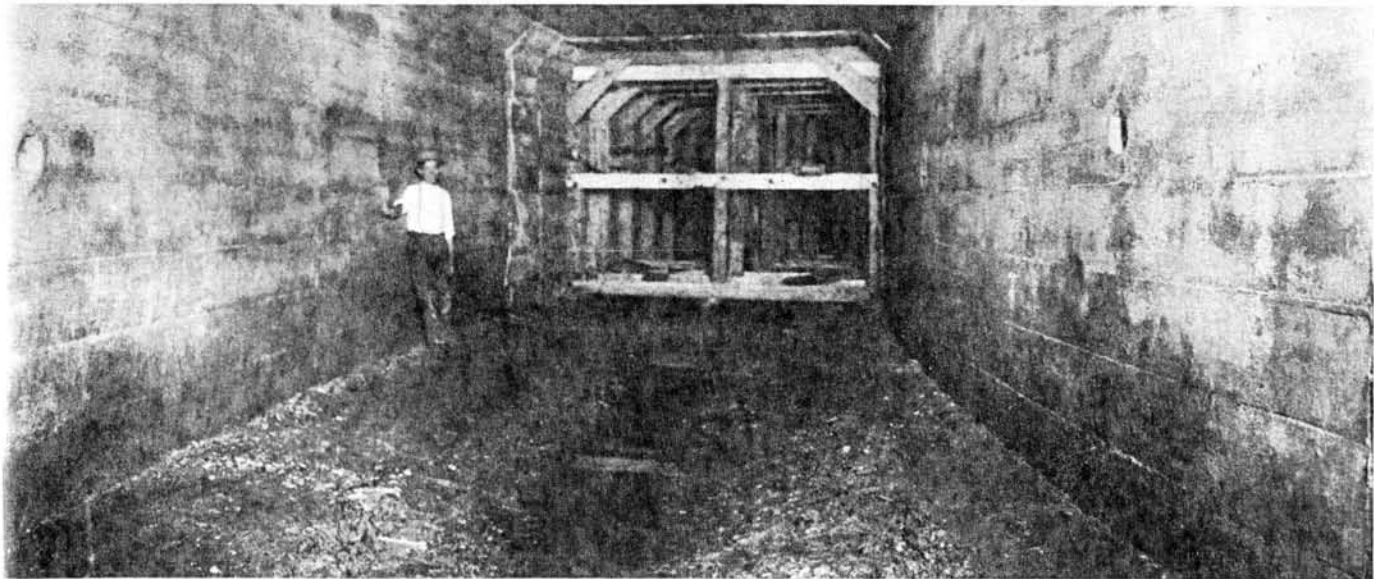
OGONTZ AVENUE SEWER, 2.78 miles in length, diameter of 10 feet 6 inches. A part of Wingohocking system. Picture illustrates appearance of completed sewer with manholes previous to grading up of street to establish level. These manholes cost \$75 to \$100 apiece.



SQUARE STEPPED SECTION OF WYOMING AVENUE SEWER east of Frankford Creek. This picture shows series of steps to break run of sewage in steep descent to remove strain from sewer. Wyoming Avenue sewer is seven feet in diameter and serves the district from Frankford Creek to the Boulevard.



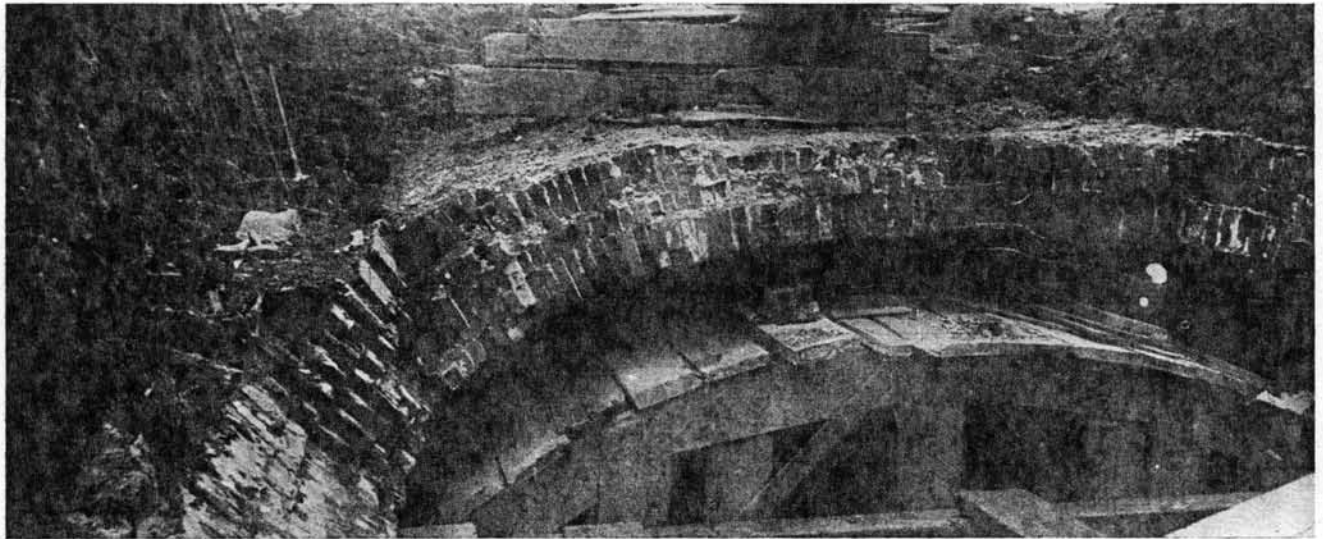
FUNCTION CHAMBER OF SEWER SHUNK AND FRONT STREETS, where two six-foot six-inch sewers run into a seven-foot six-inch sewer. This sewer is two and one-third miles in length, and built of brick.



INTERIOR OF DEVEREAUX SEWER, showing rectangular interior construction. Sewer is built of reinforced concrete.



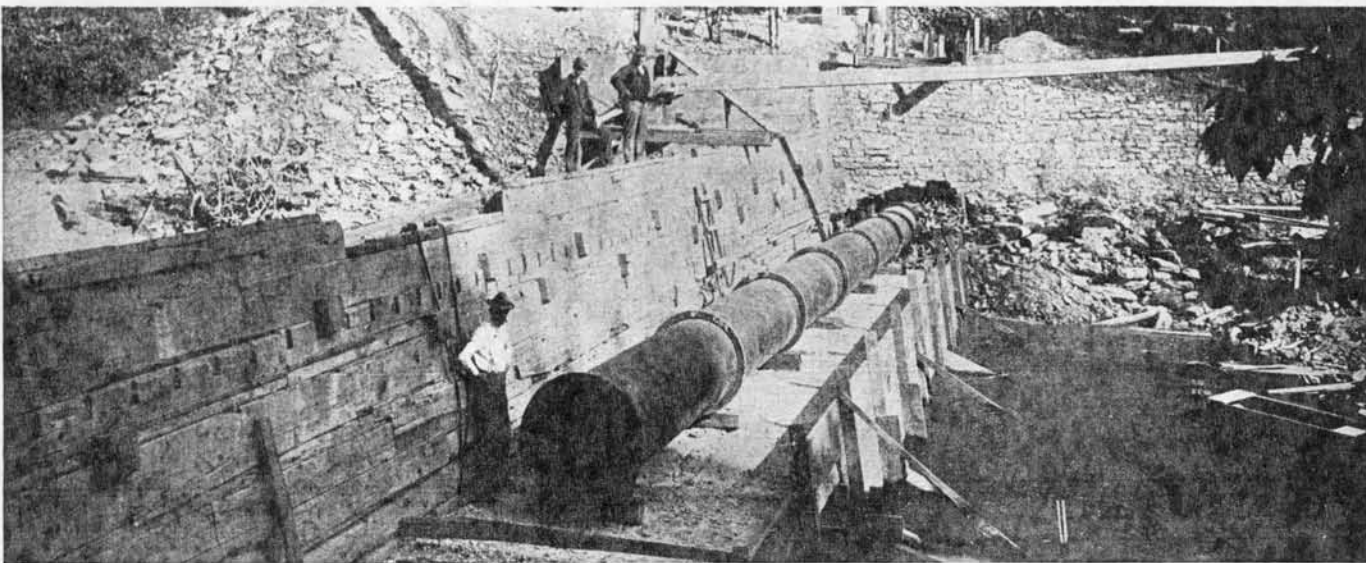
GENERAL VIEW DURING CONSTRUCTION OF ROCK RUN SEWER. This sewer is one mile in length, 12 feet in diameter. The Rock Run system of sewers has its mouth at Tacony Creek at the Boulevard and continues northwest to City Line, serving a district of 1,724 acres.



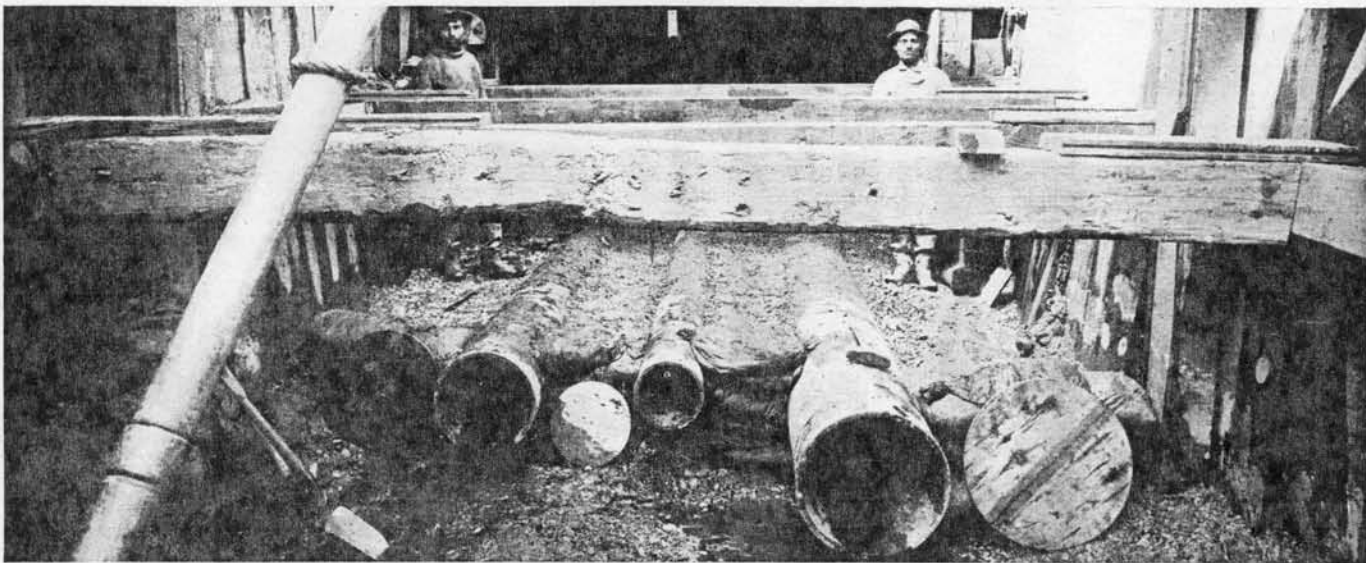
VIEW SHOWING SECTION OF OLD COHOCKSINK SEWER SYSTEM, part of the sewage system legacy from past times, which has put the City to great expense for repairs and changes to meet new requirements of State law. Section shows flat arch weakened by heavy traffic overhead, and illustrates some of the difficult work met by the Department.



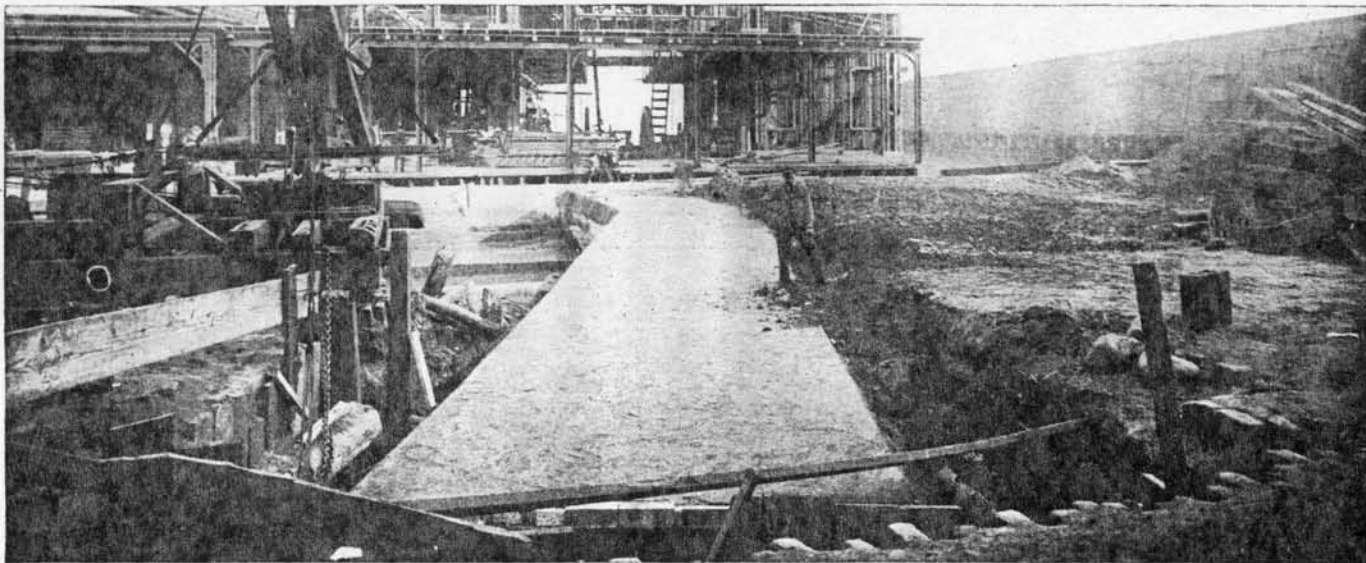
OUTFALL SECTION ON ONTARIO STREET SEWER, showing cradle resting on pile foundation. This sewer is two and one-quarter miles in length, eight feet in diameter and built of brick. It empties into the Delaware River, serving Ontario and Jasper, Delaware River to Sedgley Avenue.



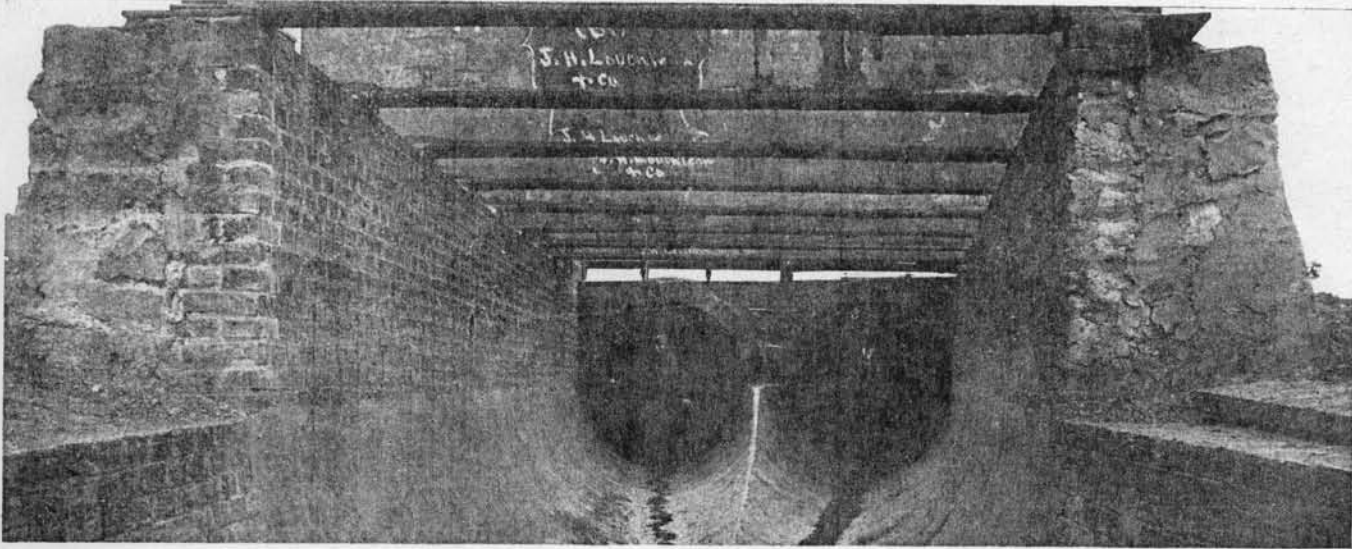
ILLUSTRATING METHOD BY WHICH SEWER, three feet in diameter, is built into Wissahickon Dam to preserve purity of the stream and care for sewage from higher level in Wissahickon. Sewage is carried to low level intercepting sewer through this dam.



PIPES OF INVERTED SYPHON by which sewage is carried under Schuylkill Canal, pressure lifting sewage to natural level after canal is crossed. Sizes of pipes are 12 inches, 14 inches and 16 inches.



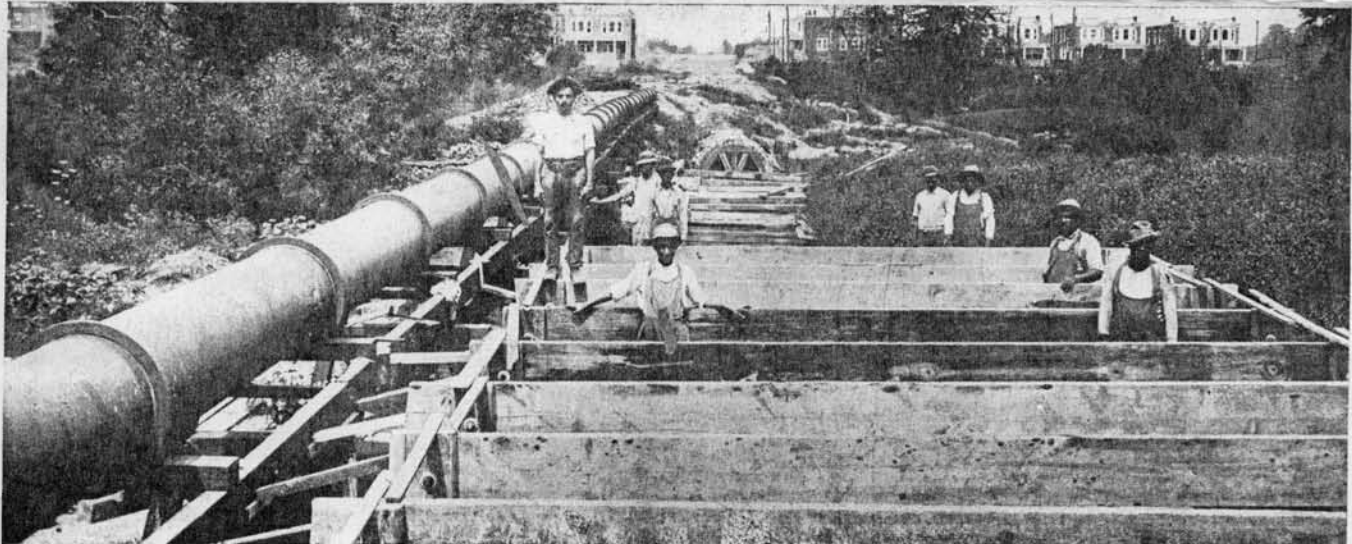
SEWER AT DELAWARE AVENUE AND SOUTH STREET, rebuilt to carry sewage under pier to conform to requirements of new bulkheading of Delaware River, and widening of Delaware Avenue for great commercial avenue.



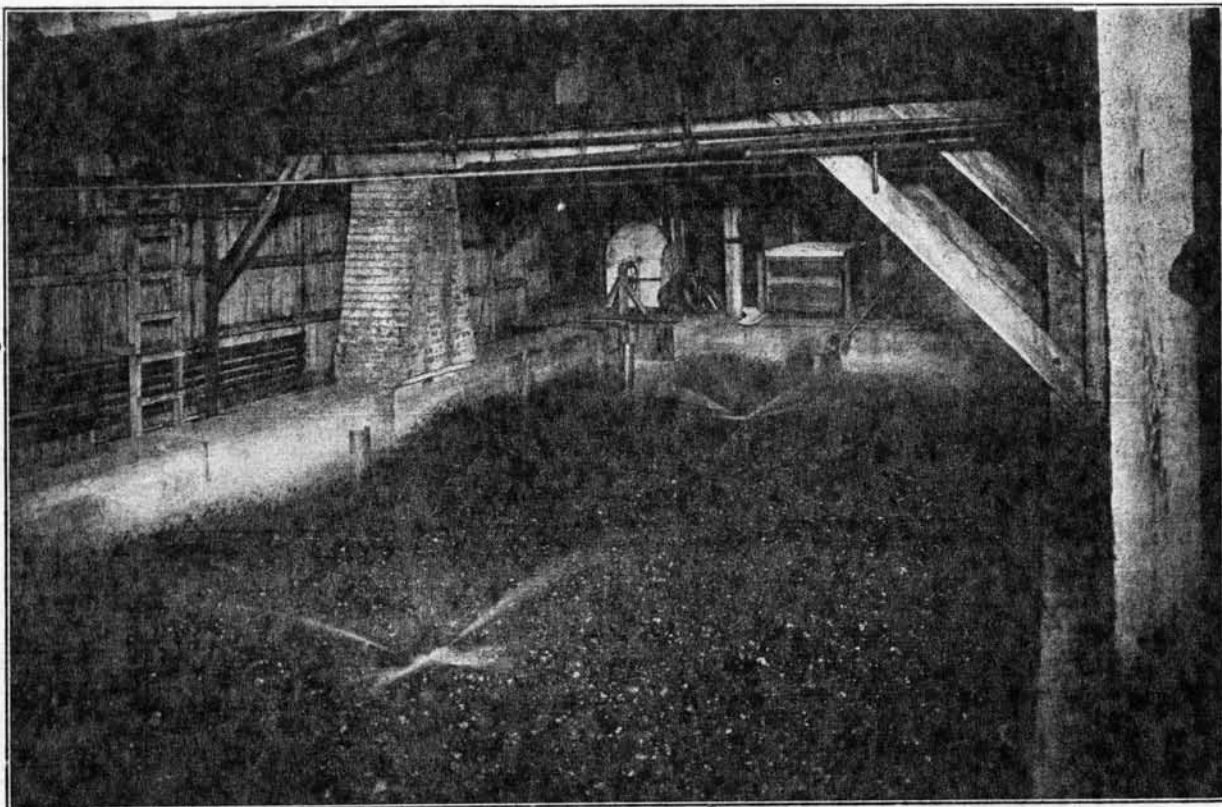
SHUNK STREET SEWER, showing section where there was not sufficient top soil to carry diameter, and steel top beams were used.



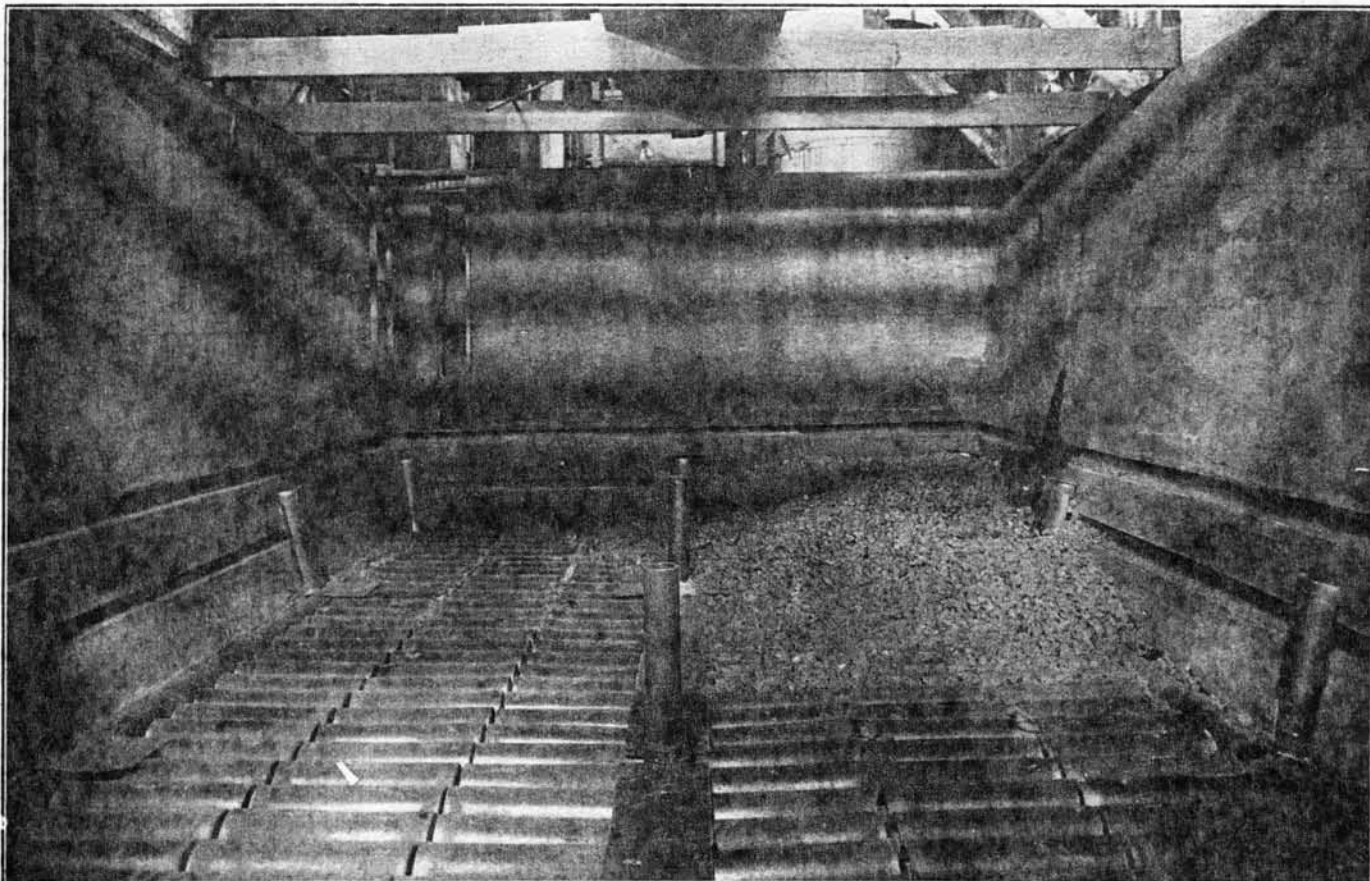
OUTFALL SECTION ONTARIO STREET SEWER, showing pile foundation, a feature in sewer construction involving considerable expense and causing delay.



DEVEREAUX STREET SEWER, showing difficulty in handling water pipe in the construction of a new sewer. Water pipe on left of picture is being transferred to new position without disturbing water service.



SPRINKLING FILTER FOR SEWAGE IN OPERATION. In this filter the solids in suspension are deposited upon the stones, undergoing a change by bacterial action from putrescible to non-putrescible form, and in granular instead of slimy condition are washed out periodically, the liquid also having been relieved of putrescible matter by bacteria.



UNDERDRAINS OF SPRINKLING FILTER FOR SEWAGE. This sprinkling filter was operated for a series of tests for fifteen months at the Spring Garden testing station to determine the rate and efficiency of this modern method of sewage purification.

Philadelphia.
Volume IV, Number 6. June 1911.
Published by the City Government.

The present number is devoted to Underground Philadelphia, Main and Branch Sewers.
“Philadelphia” may be obtained from George W. B. Hicks, Bureau of Contracts and Statistics,
Rooms 203-205, City Hall, Philadelphia.

UNDERGROUND PHILADELPHIA
No. 1.— MAIN AND BRANCH SEWERS

[PAGE 4]

At the very first step in any study of underground Philadelphia the far-reaching influence of two facts conspicuous in present-day conditions must be clearly and fully recognized: first, the steadily increasing sweep of population from the country to the city, a movement born of the wider knowledge disseminated by an unfettered and well financed press of the conditions in which life is lived to-day by all classes all over the world, bringing to a large body of the world's population discontent with that slow moving, uneventful life in which they had heretofore been ignorantly happy; second, the higher standard of living demanded by people resident in cities as an inevitable sequence of this deeper and wider knowledge regarding features in physical environment which make for the robust health and the real happiness of a people.

The direct influence, upon the activities and expenses of municipal administration of either one of these two world-working influences would have been tremendous during the past decade, for with increase in population in cities there must of necessity have developed increased demand for facilities of civilization normally associated with life in cities. On the other hand, even had population shown merely a normal increase in cities, an advancing standard of public aids to health and the increase of happiness would have placed upon the municipality the burden of a largely increased expenditure to keep pace with advancing ideals. But when it is realized that both great influences described, each making for increased expenditure and increased administrative activity, have reached their maximum influence coincidentally, it becomes apparent even to the most superficial student that a situation has developed which challenges the best ability of the world to the solving of great municipal problems.

In the old Mother City of Philadelphia these two world influences have not been sufficiently recognized by all the people, neither have they been fully appreciated, by a considerable portion of the population resident throughout the Republic. For many people, both in and out of Philadelphia, have come to regard Philadelphia chiefly as a City with a past—a City outside of or beyond the influence of those irresistible currents of public sentiment which are affecting all centers of population, classed by clear-seeing students as vital factors in the wonderful development marking these opening years of the twentieth century. For so much has been spoken and written of Philadelphia's glorious past, such a large majority of visitors to Philadelphia have come to the City of the Declaration and the Constitution for the sole purpose of visiting points of historic interest, that even a considerable section of Philadelphia's own population has forgotten that Philadelphia renewed her youth with the Centennial Exposition of 1876; forgotten, also, that the City, in every line of municipal activity, is well abreast with the most advanced cities in the world, and therefore in a position to feel, and feel strongly, any world movement bearing upon old practices in

municipal administration. Indeed, owing to certain peculiar features in her physical characteristics, Philadelphia has come more directly under the influence of these new world influences than any other American city: first, because the influences have had to do with the increase of comfort in home life, and Philadelphia with her 341,000 homes is the greatest home center in the world; second, they have represented an immense increase in City population, and Philadelphia has built more housing accommodations for new population in the past thirty-five years than in the preceding one hundred and eighty years. Moreover, a certain important and valuable body of traditions and ideals, inherited from the founder, William Penn, touching the rights of the individual, has been responsible for a body of sentiment opposing all radical change, such sentiment having been strong enough to make the task of carrying out such changes a problem of the first rank to all administrative officials. In studying the effect upon City administration, therefore, of any new influence upon administrative lines of action, Philadelphia offers opportunity to study such a problem under the most favorable circumstance, because here the new order of procedure must meet with as strong an opposition as in any other city, while the rapid development of the City and its wonderful activities in all forms of municipal life make the problem, in every sense of the word, a problem affecting real life in a real city.

Passing from the general to the particular, the new world movements of city concentrating population, and higher ideals regarding home comforts, have worked to increase the importance of such problems as may be classed under the general title of Underground Philadelphia, this subject covering the City's sewerage system, its system of water mains and connections, and its system of underground wires, gas mains and subways. In this paper investigation is limited to the subject of Philadelphia's sewerage system, or the problem represented by Philadelphia's 1,226 miles of sewers, ranging from 12 inches to 20 feet in diameter, operating in an area of 129½ square miles, giving direct connection to 248,637 separate buildings, and representing an expenditure by the City of \$25,000,000, of a gross investment, including separate building connections, in the main paid for by owners and occupiers, of \$57,000,000. This study of Philadelphia's sewerage system is of special importance at the present time, because, under a ruling of the State Department of Health, interpreting an Act "to preserve the purity of the waters of the State for the protection of the public health," approved April 22, 1905, the City of Philadelphia must submit to the State authorities before January 1, 1912, a complete plan whereby all Philadelphia sewage can be disposed of without deposit in waters of the State. The State's interpretation of the Act in question has forced the City to secure from the State Department of Health permission to lay every new sewer and, as a consequence, sewer development in Philadelphia has of late years shown the remarkable condition of a great city handling the sewage for one and a half million people under a system which the State has declared must be changed at a given date, while her engineers are rapidly developing plans for a new system, coincidentally building additions to the existing, or old system, able to serve present needs and yet conform to the new requirements regarding disposal of product.

While all municipal problems of the first rank must be regarded primarily as affecting the health and happiness of the people, [PAGE 5] of almost equal importance is the question, whether the solving of such problems places a burden upon municipal finances, or acts as an aid in producing new revenue. The economic side, therefore, of this sewer provision question forces immediate attention in any thorough study of the part which the building and maintaining of sewers plays in the government of a great city.

This study of the power of sewer construction to increase City revenue, and, incidentally, through increased revenue, increase the prosperity of the whole City, may be illustrated by taking an average land development in the undeveloped section of the City. A block of land bounded by

four main Streets, sixty feet in width, cut in one direction by two forty-foot streets and containing $5\frac{1}{3}$ acres would provide sites for 168 low-priced homes, the typical six and seven room house, with bath and modern plumbing, selling for about \$3,000, and typical of the average home occupied by the skilled worker of to-day. This land prior to occupation for building purposes, even in some of the best residential wards, would not command more than \$10,000 an acre, paying in taxes each year, even if assessed at full value and paying the highest City rate of $1\frac{1}{2}$ per cent., \$150. The City's borrowing capacity on this land in its unimproved state would be only \$700, or 7 per cent. Now imagine this same body of land converted into a suitable site for houses through construction of sewers, opening of streets, laying of water and gas mains, what would be the result? This acre of land would carry 33 dwellings assessed at about \$3,000, or, in round figures, \$100,000 in place of the original assessment of \$10,000, the improved property paying annual taxes of \$1,500 a year in contrast with the old payment of \$150, the borrowing capacity of the City on such property being \$7,000 a year in contrast with \$700. Take for a further and more favorable illustration a parcel of land in some outlying wards, and the problem would work out as follows: The average assessment for the whole ward is \$470 an acre; now, assume the land taken for building purposes to be worth double this average, or \$1,000 an acre, and bring about the same development as that supposed to have taken place on the high priced land producing 33 homes, assessed at \$3,000, or, in round figures, \$100,000 of value; the result would be as follows:—In its undeveloped condition the tract in question paid in taxes at the suburban rate of 1 per cent., \$10, and the City's borrowing capacity on this body of land at 7 per cent, was \$70. When the land in question carried its 33 homes, the tax received from the property, even at the same suburban rate of taxation, namely \$1 a hundred, or 1 per cent., would amount to \$1,000, the City's borrowing capacity being increased from \$70 to \$7,000. If the property were taxed at the full City rate of $1\frac{1}{2}$ per cent., the increase in revenue to the City growing out of the improvement would be represented by an increase in tax payments from \$10 to \$1,500. Let us go a step farther and suppose, for illustration, that only one-quarter of the territory in this large but sparsely settled ward should, as a result of good sewage and the provision of transportation, develop into a residential section similar to that already explained, the improvement of this one-quarter acreage of one of the City's 47 wards would increase the City's revenue from taxes from \$60,000 a year to \$9,000,000, the City's borrowing capacity being increased from \$420,000 to [PAGE 6] \$42,000,000. These figures stagger by their immensity and illustrate the marvelous possibilities for development offered by the present unoccupied areas within City limits. They emphasize, also, the wonderful revenue producing power of certain facilities for comfortable living, such, for example, as the unpicturesque sewer, often held in light esteem by the superficial student of economic problems. For the great majority of such students fail to recognize the great truth that no substantial building development can take place at the present day without being preceded by the creation of sewer service with its attendant water service. Consequently, the cornerstone for City building is practically represented by the creation of a system of main and branch sewers. Indeed, it can be truthfully said that sewer construction is the first step and the longest step in the journey from a small town to a large city. For not only does the construction of the sewer bring into the area of availability, at wonderfully increased rates of taxation, areas heretofore producing but small revenue to the City or to the owners of the property, but, through this land development, due to sewage provision, overcrowding is prevented, the public health is improved, and the tremendous loss to the community as a whole through loss of laboring capacity by the individual as an incident of ill health is largely avoided. The sewer, therefore, not only creates a new expression of wealth, susceptible of producing revenue to the City and increasing the City's borrowing capacity for production of funds to be used in general

improvement, but it helps to conserve and to increase the City's natural earning capacity through the continuous employment at maximum powers of its citizenship. Underground Philadelphia, therefore, as typified in the City's sewage system, holds tremendous power to make or mar the life work of every individual in the community, and its systematic and generous development has established a first claim upon the highest skill and largest resources of the City's government. In a word, the sewer—an object of little regard by all citizens, a subject unattractive in the extreme to many—may be truthfully called the path-finder for the greatest City of Homes, reaching into outlying districts and drawing, through its beneficent influence, into the area of home occupation, tracts of land of little value to present-day owners, because useless as sites for healthy homes for a happy and contented people.

Coming a little closer to the subject, Philadelphia's sewers to-day have a total length of 1,226 miles, a length sufficient, if placed end on end, to reach from Philadelphia to New Orleans. During the life of the present administration, or in the years 1907-8-0-10, 137 miles, or 11¼ per cent. of this whole system has been constructed, this work representing 1,004 separate pieces of sewer construction, or an average of nearly one piece of sewer work completed for every working day during the past four years. When the consolidation of the twenty-eight outlying districts into the present day Philadelphia became effective 56 years ago, the City had in operation only 36 miles of main and branch sewers. The population at this time was about one-third of present day population, and on this basis there should be to-day in operation only 108 miles of sewers, whereas there are now in operation 1,226 miles. To-day, therefore, the per capita sewage provision is 11⅓ times greater than when Philadelphia consolidated in 1854, although the City at that date had to its credit 171 years of incorporated existence.

Broadly speaking, the City of Philadelphia is served by the following systems of sewers: West Philadelphia: First, Mill Creek sewer, 20 feet in diameter, which empties into the Schuylkill at Forty-fifth street, extending northwest to City line at Overbrook, serving an area of 4,310 acres; second, Thomas Run sewer, emptying into Cobb's creek at Florence avenue, extending north to Fifty-sixth and Arch, serving area 1,100 acres; third, Charles creek sewer, mouth at Sixty-seventh street, west to Sixty-fifth and Woodland avenue.

South Philadelphia: First, Passyunk avenue system, which runs from its mouth, Schuylkill river, out Passyunk avenue to Sixteenth and Wharton, serving area of 805 acres; second, Oregon sewer, mouth in Delaware river at Oregon avenue, runs west to Broad street.

North and Central Philadelphia are served by four systems: First, Rock Run system, [PAGE 7] mouth in the Tacony creek, along the Boulevard, in a northwesterly direction to Oak Lane, serving a district of 1,724 acres; second, Wingohocking system, mouth in Tacony creek, out Wingohocking street northwest to Chestnut Hill, serving district of 5,475 acres; third, Gunner's Run system, mouth in the Delaware river, out Somerset street in a northwesterly direction to Tioga, serving a district of 2,420 acres; fourth, Cohocksink system, mouth in the Delaware river, out Camac street in northwesterly direction to Strawberry Mansion, serving 2,850 acres.

Northeast Philadelphia: First, the Frankford intercepting system from a point on Frankford creek out Wakeling street to Lawndale, serving a district of 2,560 acres; second, Wissinoming system, from the Delaware river out Lardner street northwesterly, serving district of 1,217 acres.

Northwest Philadelphia has an intercepting system, serving Chestnut Hill, Germantown, Manayunk and Falls of Schuylkill, a district of 5,500 acres.

No study of Philadelphia's present day sewers and sewerage system would be complete without reference to the extensive experiments systematically carried on during the present administration with the object of developing a general plan of sewage disposal that would conform

to the requirements of the Act of Assembly forbidding pollution of waters of the State. Every permit granted by the State Commissioner of Health to build a new sewer since the passage of this Act, has contained the following conditions: "The City of Philadelphia shall prepare and submit to the State Department of Health by January 1, 1912, a comprehensive plan for the collection, purification and disposal of sewage for the entire City, and that designs for the extension of existing system shall not be at cross purposes with this plan, and also that some progress shall be made during each year toward this end." As a preparatory step in this important work expert officials of the City inspected important modern sewage-disposal and purification plants in the United States and the principal cities of England, France and Germany. Coincidentally, the Engineering Department has obtained plans and data concerning the amount of land required for the various methods used, comparative cost of construction and operation, capacities and efficiencies of plants operated and the influence of local conditions.

The whole question of sewage and sewage disposal in its modern development illustrates the growing recognition of man's, responsibility to his fellow-man, and the more perfect co-operation between individuals and communities in all that goes to affect life, liberty and the pursuit of happiness. Nothing more clearly illustrates this changing point of view than recent legislation looking to the preservation of streams by forbidding use of streams as deposit points for sewage matter. Up to very recent times, even in the disposal of home refuse, individuals would, in the large majority of cases, wholly disregard the rights of neighbors. In fact, some of the most difficult police work has been enforcement, through the Department of Health, of certain necessary restrictions on the individual in connection with this very matter of trespassing upon the rights of his fellow-citizen. The same tendency to individual selfishness has found repeated manifestation in a larger degree in relations between towns and cities, one town emptying its refuse into a stream from which another drew supply of drinking water. Only within recent years has public sentiment reached a condition which enforced legislation safeguarding the rights of others—between individuals and between separate communities—and the conservation of all streams has become the settled policy of nearly all States. While this water conservation policy has put upon all incorporated centers of population a heavy expense to provide means of sewage disposal, such an expenditure will be fully returned through increased health and a consequent increased earning capacity in the people so benefited, while in addition to all this that is material in its character and easily estimated in dollars and cents, there is to be taken into account the greater benefit certain to result from this public recognition by both individuals and communities of the necessity to consult the rights of others in all that makes provision for the day by day wants and requirements of twentieth century civilization.

Text accompanying sewer map, pages 8-9

The City of Philadelphia is served by the following Systems of Sewers:

In West Philadelphia, first, by the Mill Creek sewer, 20 feet in diameter, which empties into the Schuylkill at Forty-fifth street, extending in a northwesterly direction to the City line at Overbrook, directly serving an area of 4,310 acres. Second, by the Thomas Run sewer, emptying into Cobb's creek at Florence avenue and extending north to Fifty-sixth and Arch, directly serving an area of 1,100 acres. Third, Charles creek sewer, which, from its mouth at Sixty-seventh street, runs west to Sixty-fifth and Woodland avenue, this system being farthest south of any system west of the Schuylkill river.

South Philadelphia is served, first, by the Passyunk avenue system, which runs from its mouth, Schuylkill river, out Passyunk avenue east and north to Sixteenth and Wharton, serving an area of 805 acres. This system is the most southerly one west of Broad street. Second, Oregon sewer, which from its mouth the Delaware river at Oregon avenue, runs west to Broad street, and at present serves 55 acres, being the farthest system east of Broad street in South Philadelphia.

North and Central Philadelphia are served by four systems: First, Rock Run system, extending, from its mouth in the Tacony creek, along the Boulevard in a northwesterly direction to Oak Lane, serving a district of 1,724 acres. Second, Wingohocking system, extending from its mouth in Tacony creek, out Wingohocking street northwest to Chestnut Hill, and serving a district of 5,475 acres. Third, Gunner's Run system, extending from its mouth in the Delaware river out Somerset street in a northwesterly direction to Tioga, serving a district of 2,420 acres. Fourth, Cohocksink system, extending from its mouth in the Delaware river out Camac street in a northwesterly direction to Strawberry Mansion, serving 2,850 acres, including Norris street outlet.

Northeast Philadelphia is served by two systems: First, the Frankford intercepting system from a point on Frankford creek out Wakeling street to Lawndale, serving a district of 2,560 acres. Second, Wissinoming system, from the Delaware river out Lardner street northwesterly, giving service to a district of 1,217 acres.

Northwest Philadelphia has the service of an intercepting system: Chestnut Hill, Germantown, Manayunk and Falls of Schuylkill, a district of 5,500 acres.

CAPTIONS

Page 1 (Cover)

Type of rectangular reinforced concrete sewer, 13 feet x 11 feet. Philadelphia's sewerage system is 1,226 miles in length, or equal to the distance from Philadelphia to New Orleans, it cost \$37 million.

Page 5

DIFFICULT AND EXPENSIVE ROOK WORK ON WISSAHICKON HIGH LEVEL, CUT-OFF. This sewer is six feet in diameter and about four miles in length, and lies from 40 to 150 feet below the surface. It will serve the higher elevations along the Wissahickon Creek. When completed it will be four miles in length, and cost the City \$750,000.

Page 6

MILL CREEK SEWER. This great sewer is eight miles in length. When first built it extended a mile before reaching any built-up section. Building operations followed so rapidly upon its completion that increase in values within a period of two years returned the City, in taxes,

more than the total cost of the whole sewer. The diameter of the sewer is 20 feet, being the largest in the City of Philadelphia

Page 7

MILL CREEK SEWER after upper section was built. This sewer extends from its mouth in the Schuylkill at Forty-fifth street northwest to City Line at Overbrook, and serves an area of 4,310 acres.

Page 10

SHAWMONT INTERCEPTING SEWER, about three-fourths of a mile in length, serving Roxborough Filter Beds and environs, intercepting sewage from the Schuylkill River.

WINGOHOCKING SEWER SYSTEM on Annsbury Street; 14.8 miles in length; when completed it will be 16.11 miles in length; built of brick; diameter 17 feet 6 inches; will be 20 feet in diameter at outlet into Frankford Creek when completed. This sewer system serves one of the most important sections of the City, emptying into the Frankford Creek at Wingohocking Street and carrying sewage for the northwestern district as far as Chestnut Hill, altogether serving a district of 5,500 acres, largest drainage area in City.

OGONTZ AVENUE SEWER, 2.78 miles in length, diameter of 10 feet six inches. A part of Wingohocking system. Picture illustrates appearance of completed sewer with manholes previous to grading up of street to establish level. These manholes cost \$75 to \$100 apiece.

Page 11

SQUARE STEPPER SECTION OF WYOMING AVENUE SEWER east of Frankford Creek. This picture shows series of steps to break run of sewage in steep descent to remove strain from sewer. Wyoming Avenue sewer is seven feet in diameter and serves the district from Frankford Creek to the Boulevard.

JUNCTION CHAMBER OF SEWER SHUNK AND FRONT STREETS, where two six-foot six-inch sewers run into a seven-foot six-inch sewer. Ts sewer is two and one-third miles in length, and built of brick.

INTERIOR OF DEVEREAUX SEWER, showing rectangular interior construction. Sewer is built of reinforced concrete.

Page 12

GENERAL VIEW DURING CONSTRUCTION OF ROCK RUN SEWER. This sewer is one mile in length, 12 feet in diameter. The Rock Run system of sewers has its mouth at Tacony Creek at the Boulevard and continues northwest to City Line, serving a district of 1,724 acres.

VIEW SHOWING SECTION OF OLD COHOCKSINK SEWER SYSTEM, part of the sewage system legacy from past times, which has put the City to great expense for repairs and changes to meet new requirements of State law. Section shows flat arch weakened by heavy traffic overhead, and illustrates some of the difficult work met by the Department.

OUTFALL SECTION ON ONTARIO STREET SEWER, showing cradle resting on pile foundation: This sewer is two and one-quarter miles in length, eight feet in diameter and built of brick. It empties into the Delaware River, serving Ontario and Jasper, Delaware River to Sedgley Avenue.

Page 13

ILLUSTRATING METHOD BY WHICH SEWER, three feet in diameter, is built into Wissahickon Dam to preserve purity of the stream and care for sewage from higher level in Wissahickon. Sewage is carried to low level intercepting sewer through this dam.

PIPES OF INVERTED SYPHON by which sewage is carried under Schuylkill Canal, pressure lifting sewage to natural level after canal is crossed. Sizes of pipes are 12 inches, 14 inches and 16 inches.

SEWER AT DELAWARE AVENUE AND SOUTH STREET, rebuilt to carry sewage under pier to conform to requirements of new bulkheading of Delaware River, and widening of Delaware Avenue for great commercial avenue.

Page 14

SHUNK STREET SEWER, showing section where there was not sufficient top soil to carry diameter, and steel top beams were used.

OUTFALL SECTION ONTARIO STREET SEWER, showing pile foundation, a feature in sewer construction involving considerable expense and causing delay.

DEVEREAUX STREET SEWER, showing difficulty in handling water pipe in the construction of a new sewer. Water pipe on left of picture is being transferred to new position without disturbing water service.

Page 15

SPRINKLING FILTER FOR SEWAGE IN OPERATION. In this filter the solids in suspension are deposited upon the stones, undergoing a change by bacterial action from putrescible to non-putrescible form, and in granular instead of slimy condition are washed out periodically, the liquid also having been relieved of putrescible matter by bacteria.

UNDERDRAINS OF SPRINKLING FILTER FOR SEWAGE. This sprinkling filter was operated for a series of tests for fifteen months at the Spring Garden testing station to determine the rate and efficiency of this modern method of sewage purification.