A CENTURY OF THE PITTSBURGH WATERWORKS*

By E. E. Lanpher†

Descriptions of portions of the waterworks of the City of Pittsburgh have on several occasions, been presented to this Society. However, there has been presented no general description of the plant, and the occasion of the centennial anniversary of the completion of a waterworks system in the central portion of Pittsburgh is an appropriate time to present some of the history, and a description of the present water plant.

Tables of plant and operation costs, services rendered and results obtained are purposely omitted, as they belong to the realm of municipal reports.

Historically and topographically, the waterworks is separated by the Monongahela, Allegheny and Ohio rivers into three parts—the central city or "peninsular" Pittsburgh, the North Side (formerly Allegheny), and the South Side.

THE CENTRAL CITY

The first known attempt to obtain a public water-supply is recorded in the following enactment of the Borough of Pittsburgh, when that municipality contained about 1600 persons.

"Be it ordained by the Burgesses, Freeholders and other inhabitants, housekeepers of the Borough of Pittsburgh, in town meeting duly assembled, at the Court House, the 9th day of August, 1802, that the Burgesses are hereby authorized and empowered to have wells sunk and pumps erected in such parts of this Borough as they think most advisable, beginning with Market Street. And it is further ordained that where individuals have, at their own expense, sunk wells and erected pumps in the streets, in useful and necessary parts of the Borough, that a compensation be made to them in case of their assigning them for public use. The whole expense to be defrayed by a general tax on the Borough.

Isaac Craig, Chief Burgess.
David Evans, Burgess."

The estimate of expense accompanying this ordinance was $497.96, and it is certain that at least $170 was collected, and that Walter Christy, Borough Clerk, called for proposals for four public

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wells on Market Street, which were to be dug to a depth of not less than 47 feet, and for the pumps to equip the wells.

In December 1813, George Evans served notice that he was ready to pump water sufficiently high, by steam power, to run to any part of the town and to supply consumers at three cents a barrel. Again, in January 1818, William B. Foster and William Hamilton petitioned for permission to supply water, but there is no record that either of these two projects materialized.

In 1824, the first definite steps were taken to obtain a general waterworks system. On February 24, Council finally passed an ordinance providing for a loan of $50,000 to construct the necessary works. Supervision was placed in a water committee composed of Messrs. Fairman, Magee, Denny, Carson and Hays. The Pittsburgh and Exchange banks advanced funds on the loan, and the committee purchased an engine-house site at the corner of Duquesne Way and Cecil Alley for $1425; also a lot 240 feet square on Grant Street (the present Court House site) for $3800, upon which to construct a reservoir.

An additional loan of $40,000 was raised in 1826, and contracts were let in December of that year for a steam pumping-engine and a reservoir. It was specified that this pumping-engine was to be able to raise 60,000 gallons in 12 hours to a reservoir of 1,000,000 gallons capacity, at an elevation of 80 feet above the town.

The plant was turned over for operation in September 1828. So much difficulty (mainly breakage of pump and pipes) was experienced that little water was delivered to consumers until 1829; in fact, it appears that the first water revenue accounted for was $3086 in 1829. The water consumption for the first three years did not exceed an average of 40,000 gallons a day, and the pumping-engine was operated about 21 hours a week.

By 1832, the water consumption had materially increased, making it necessary to purchase a second pumping-engine. The plant at this time was termed to be "in good working order" and represented an investment of $111,086.52.

During the 10 years following the opening of the plant, the city had expanded to the hill district east of Grant Street; also complaints were registered in regard to the contamination of the river water near the intake of the Cecil Alley pumping station. This resulted, in 1838,

in Council instructing the Water Committee to construct a larger pumping plant at a point "above the City," and a larger and higher reservoir. Mr. R. Moor, described as a mechanical and hydraulic engineer, was engaged to supervise the work. At this time, the city purchased a pumping-station site at Eleventh and Etna streets, and a reservoir site at Prospect and Elm streets (the Washington Park site). The enlarged plant was placed in operation July 4, 1844. It consisted of the pumping station on Eleventh Street, generally called the "lower works," equipped with two steam-driven pumps known as "Samson" and "Hercules," of a combined capacity of 9,000,000 gallons a day, each with a cylinder diameter of 18½ inches and a 12-foot stroke, pumping to the Prospect Street reservoir, known as the "lower basin," at an elevation (floor level) of 160 feet above the river. The "lower basin" had a capacity of about 7,500,000 gallons. The Cecil Alley plant and the Grant Street reservoir were abandoned at this time.

It should be noted that 9,000,000 gallons a day of pumping equipment was installed at a time when the water consumption was 1,500,000 gallons a day; that it was 20 years before additional pumping equipment was installed at the "lower works," and that "Samson" and "Hercules" functioned almost continuously until 1884—a period of 40 years.

In 1847, filtration of the water-supply was first recommended. It required a lapse of 60 years for filtration to become a reality.

In 1848, just 20 years after the completion of the first plant, the continued progress of the city toward the eastern hill section forced the building of a reservoir at Erin Street and Bedford Avenue, and a small station at the "lower basin" to pump to it. This reservoir, at an elevation of 398 feet, with a capacity of 2,700,000 gallons, was known as the "upper basin," while its pumping station was known as the "upper works." This station began operation in 1850 and continued until 1893.

In 1853, after 25 years of development, the average daily pumpage was 2,805,568 gallons; the population about 56,000; the plant valuation about $500,000, and the plant consisted of one primary and one secondary station, two small reservoirs and about 24 miles of pipe. The annexation, in 1867, of 14 wards and about 35,000 people, following the rapid growth of the old city, brought on a general shortage of the water-supply. Additional pumping units were installed, and a

small temporary pumping station was erected at Forty-fifth Street and the Allegheny River in 1870. Its three small pumps delivered an average of less than 1,000,000 gallons a day directly into the distribution system until 1880.

While the matter had been under discussion for about five years, it was 1871 before the Water Committee finally recommended the construction of a pumping station above Negley's Run, the construction of a low reservoir on Brilliant Hill (now Lake Carnegie), and a high-service reservoir at the head of Highland Avenue. It was a year later before authorization to proceed was obtained, and 1879 before any of this new plant was operated. While the work at Brilliant station and Highland reservoir was in progress, there was authorized the construction of a reservoir on Herron Hill and a secondary station to supply it at Dithridge Street, near the present Bigelow Boulevard.

In 1878, after 50 years of plant operation, the pumpage had increased to over 15,000,000 gallons a day, the population to about 106,000, the consumers to about 8000, and the plant valuation to about $2,000,000, exclusive of work under construction. The plant consisted of two primary pumping stations and one secondary station, two small reservoirs, and 105 miles of pipe-lines; also two pumping stations and three reservoirs under construction.

Brilliant Hill reservoir, although practically completed, was never used as a portion of the water-works system. It is now used as a park lake.

The first attempt, February 18, 1879, to supply water from Highland reservoir, failed, due to unconnected discharge pipes and to pipe breakage. Two days later a more successful attempt was made. Water was first turned into a small section, the resulting pipe breakage repaired, then extended into an enlarged district. This procedure was continued until March 5, when the water from Highland reservoir finally reached the "Point" section of the city. About four years were required to correct the major faults at Brilliant station and Highland reservoir.

The Herron Hill reservoir, and the original Herron Hill pumping station, started in 1878, were completed early in 1880, and the first water from this system was supplied to consumers on June 26 of that year. The one pump installed (with a capacity of 1,500,000 gallons a day) was transferred from the "upper works." The capacity

of Herron Hill reservoir is 12,000,000 gallons, and its elevation is 563 feet, Pittsburgh datum. The daily pumpage to this reservoir during the first year of its operation was less than 900,000 gallons.

The Forty-fifth Street station was closed February 24, 1879, following the opening of Highland reservoir. Except for continuous pipe-line extensions to meet the need of a rapidly extending city, there were no major plant developments from 1880 to 1890.

Three isolated high hills next received attention. In 1890 and 1891, a small secondary pumping station was erected at Evaline Street, pumping to a single tank at an elevation of 512 feet. This station and tank continued to supply the Garfield and Heberton Hill sections until 1914.

Again in 1895, a similar small pumping station and tank were installed to supply the Lincoln section. This Lincoln station was built at Park Avenue and Dearborne Street, while the tank was located near the eastern boundary line of the city at an elevation of 583 feet.

In 1897, a contract was awarded for the construction of Highland reservoir No. 2—the lower reservoir in Highland Park—at an elevation of 277 feet, with a capacity of 126,000,000 gallons. This reservoir, installed for the service of the low-lying sections along both rivers, for which the abandoned Brilliant Hill reservoir had been built, was finally completed, after many trials, in 1903.

The rapid development of the Squirrel Hill section forced the building of a new and larger Herron Hill pumping station at the corner of Center Avenue and Dithridge Street. This station was completed, and the old station abandoned in 1897.

In the latter part of the nineteenth century the contamination of the Allegheny River had reached such a stage that serious consideration of water purification became a matter of necessity. One of the first moves in this attempt to better the character of the water-supply was a combined meeting of the Engineers' Society of Western Pennsylvania, the Chamber of Commerce, the Allegheny County Medical Society, and the Iron City Microscopical Society, whose proceedings were published in 1894.

The citizens ranged themselves into three major groups—those in favor of the filtration of the existing supply; those who favored bringing water from distant uncontaminated sources; and those satisfied with existing conditions. Finally, by resolution of June 10, 1896,

Councils provided for the appointment of a Filtration Committee composed of the Mayor, the Presidents of Select and Common Councils, and eight representative citizens. Their report was submitted in January, 1899, and recommended the installation of a slow-sand filtration plant and the water-meter system. The issuing of the first of the so-called "filtration bonds" was approved by the people at an election held September 19, 1899. On the northern bank of the Allegheny River, east of Aspinwall and nearly opposite Brilliant station, the Pittsburgh filtration plant was started in 1905, after four years of intense argument, and after various designs, and redesigns. The first filtered water was delivered December 18, 1907. Additional filtered water was delivered to "peninsular" Pittsburgh as rapidly as individual filters could be completed, and on October 3, 1908, its entire supply was filtered.

The South Side received its first filtered water on February 4, 1909, and the North Side on March 29, 1914.

The filtration plant, as first constructed, consisted of a low-lift pumping station, known as Ross station, equipped with four centrifugal pumps each with a capacity of 35,000,000 gallons a day, a receiving basin, two sedimentation basins, 46 covered slow-sand filters, a filtered-water basin, and the necessary conduits and piping. There were later added to this plant 10 filters to meet the requirements of the North Side, and a contact baffle, or Reisler, pre-filtration system. This work was done in 1912 and 1913.

Due to the consolidation of Pittsburgh and Allegheny December 6, 1907, and to the purchase by the city of the water plant of the Monongahela Water Company in 1908, the three waterworks were merged at that time into a greater city waterworks.

NORTH SIDE

In 1847, Allegheny made its first definite steps to obtain a public waterworks. In that year a committee, consisting of Messrs. Riddle, Painter, Lothrop, Warner, and Alexander, was appointed and within two months reported that it had purchased seven acres of ground on Troy Hill, then in Reserve Township, for a reservoir site, and a lot of ground on Bank Lane, now River Avenue, for a pumping-station site. Council immediately approved the purchases, issuing the necessary bonds in payment, and further issuing $100,000 in bonds

with which to construct a waterworks. River Avenue pumping station and Troy Hill reservoir were first operated in 1849, and the cost of the complete waterworks to January 1, 1850, was $265,985.23. The original pumping-engines served in this station until a larger unit, a Lowry, was completed in 1874. This Lowry pumping-engine, together with two Allis pumping-engines installed in 1884, and two Wilson-Snyder pumping-engines installed in 1888, were in service at the time of the consolidation of the two cities in 1907.

In 1871 and 1872, a pumping station containing one small pump was built at the Troy Hill reservoir to supply the adjacent high territory.

The growth of the city into the northern hills made necessary the building of Howard Street pumping station, drawing its supply from the mains of the River Avenue system and pumping to a single tank on Nunnery Hill at an elevation of 502 feet. This work was completed in 1882, and a new engine was added in 1885, a new tank on Spring Hill in 1886, and another on Nunnery Hill in 1888.

Allegheny decided in the early 'nineties to go far outside the city limits to obtain a purer supply of water. Montrose pumping station, located on the Allegheny River near Hoboken, about nine miles from the center of the city, was constructed in 1896, and continued to supply the city until 1914, when, after the consolidation, Aspinwall pumping station took its place. The only other major plant development of the Allegheny waterworks prior to its consolidation with the Pittsburgh waterworks was the installation of Greentree station and tanks in 1904. This small station, located on Broadway, took its supply from the Lafayette system, and pumped to two small tanks at an elevation of 690 feet—the highest point within the present city of Pittsburgh, and located on Montana Hill, at the extreme northerly boundary of Allegheny.

SOUTH SIDE

The Monongahela Water Company served that portion of the city south of the Monongahela and Ohio rivers, as it existed prior to recent annexations. Its charter was dated 1855; however, it was 1865 before active work was started on its water plant. At this time a pumping station on the Monongahela River at South Twenty-ninth Street, and Birmingham reservoir at the head of South Thirtieth Street, were put in service. In 1875, a small pumping station was

constructed at Birmingham reservoir for the supply of the hill section. The first Allentown tank was installed in this system in 1895, and two additional tanks were built in 1904. These tanks are in Grandview Park, and at an elevation of 598 feet.

This Monongahela water plant was purchased by the city in 1908. With the exception of Allentown tanks, and the distribution mains, very little of the Monongahela Water Company plant, as purchased, is now in existence.

GREATER PITTSBURGH

With the consolidation of Pittsburgh and Allegheny in 1907, and the purchase of the Monongahela Water Company in 1908, the city faced the necessity of extending its filtered-water service to include the enlarged territory, and of consolidating three waterworks, separated by rivers, into one general system.

River Avenue station on the North Side was closed at once, and the supply from Montrose station was chlorinated, beginning in 1911.

On the South Side, soon after the purchase of the plant, water for the low-lying district was fed directly from Highland reservoir No. 2, and the South Twenty-ninth Street station, relieved of this service, took over the work of pumping water to the Allentown tanks, formerly done by Hill station. At this time Hill station and Birmingham reservoir were abandoned. Mission station, on Mission Street near South Eighteenth Street, was started in 1909 and placed in service November 12, 1912. This good example of a secondary pumping station replaced the antiquated South Twenty-ninth Street station, which was abandoned.

The building of Aspinwall station on filtration plant property, for the general supply of the North Side, was started in 1911, and water was first delivered from this station March 28, 1914. In this same system, Cabbage Hill, or North Side reservoir, was started in 1912, and completed in September 1914. This reservoir, with a capacity of 155,000,000 gallons, at an elevation identical with that of Highland reservoir No. 2, is located in Shaler Township, between the boroughs of Millvale and Etna. The opening of Cabbage Hill reservoir marked the passing of Troy Hill reservoir and Troy Hill pumping station. While Montrose station is held intact, it has not

operated since 1915. Garfield station and tanks finally gave up their duties in 1912, in favor of Herron Hill reservoir.

During the years of the World War and the subsequent period of reconstruction no important changes were made in the water plant. In 1926, provision was made for a large amount of work, most of which is uncompleted. It comprises a large number of pipe-line projects, particularly rising mains; the rehabilitation of Ross and Brilliant stations; the electrification of Howard and Herron Hill stations; the relining of Highland reservoir No. 2; and the building of two reservoirs in the high district of the North Side to replace the Montgomery, Lafayette, and Greentree tanks.

In 1828, one pump, its engine operated by steam from one boiler, served, through about 1½ miles of pipe and one reservoir, a city of about 10,000 people with raw river water at a maximum water pressure of about 34 pounds. The waterworks served a territory of about one-half of a square mile in extent. Now, at the end of a century of successful operation, the Pittsburgh waterworks serves 37 square miles of territory, a population of 590,000, with a daily average of 118,076,000 gallons of filtered water at an average pressure of 79 pounds. Its plant valuation on a used and useful historical basis is about $34,500,000, and its reproduction valuation is about $65,000,000.

Listing only the major items, its plant consists of a slow-sand filtration plant with a capacity of 168,000,000 gallons a day; a low-lift pumping station equipped with five pumps of a combined capacity of 255,000,000 gallons a day; two primary pumping stations equipped with 13 pumps of a combined capacity of 196,000,000 gallons a day; four secondary and one tertiary pumping stations equipped with 16 pumps of a combined capacity of 69,000,000 gallons a day; a filtered water reservoir, storing 50,000,000 gallons; five reservoirs and 12 tanks, storing in the distribution system 413,000,000 gallons; 13.65 miles of rising mains, eight inches to 96 inches in diameter; 812.28 miles of distribution mains, four inches to 66 inches in diameter; 18,993 distribution valves; 7483 fire hydrants; 105,382 water services; and 44,475 water-meters.

DISCUSSION

J. P. LEAF:* It is wonderful to see how the death rate has gone down. While we always take typhoid fever as the index, we do not know how many other diseases have been brought in by the same conditions, and these figures do show improvement in the case of other diseases as well as typhoid fever.

In 1824 the members of the Economite Society moved into a new location at Economy, Pa. They were located on a gravel bank without water and they brought their water from springs up on the hill. In 1915 we were putting in some sewers through a low place and ran into some of their old water line and recognized their old pipe-line and took out a piece and took it to Mr. Duss, and we also sent a piece to the Carnegie Museum. In a few days Mr. Rapp sent us a letter describing the laying of this line. It was written in German, so I did not bring it along because I could not read it. But what he said was something like this, that they had piped a spring down into the town by taking white-oak logs eight to ten feet long, boring 2½-inch holes through them, and putting those logs together with iron ferrules about 2½ inches long and three or four inches wide. The logs with the ferrule connections were driven together with a heavy maul. That water line existed and supplied Economy with water from 1824 to about 1900. Then they put in a pumping plant and dug a well to the underflow, and at Ambridge they built a water-works and used that same underflow; so that the borough of Economy has been using that conduit since 1824.

I have here a piece of one of the logs, taken from the end and showing the joint. I have the other piece and it is so hard I could not saw it, so I did not bring it; but you can readily understand from this how the joint was made. This was in good condition when I got it, but after I took it out of the ground it dried out and cracked. The ferrule was also in good condition when found, but it has rusted since. It is a piece of 1/32-inch iron sharpened to a knife-edge on either side, with a narrow rim shrunk around it. This was put between the logs when they were laid and the logs were driven together with a heavy maul. I found a place where they made a tap by taking an auger and boring a hole through the log and putting a pipe in.

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J. N. CHESTER:* Did that supply the reservoirs, or were those reservoirs built after the pumping plant was put in?

J. P. LEAF: No; it was simply from the spring. The letter I mentioned stated that the original spring water head had a flow about the cross-section of a rye-straw and they had to go to several other springs and connect up enough of them to supply the town all the time. I would be glad to furnish a copy of that letter if anybody can read it.

J. N. CHESTER: How long was it in service before it was exposed?

J. P. LEAF: I dug this out in 1915. They had been using the water for 76 years, up to 1900.

J. N. CHESTER: Then 13 years of exposure to the atmosphere has been more severe on it than 91 years in the ground.

J. P. LEAF: This was in a swamp; but, with the water inside, it was well preserved. The length dug up was probably 25 or 30 feet, and when I discovered what it was I got what I wanted and other people took the rest.

J. N. CHESTER: These same Economites built another works in Leetsdale, and Mr. Leaf referred to the reservoir they built on top of the hill, at Economy, of stone and concrete. They are in a pretty good state of preservation yet, both at Leetsdale and at Economy. I now have to do with the one at Leetsdale. That reservoir is fed from a spring on top of the hill and it is still flowing, not to that reservoir but into the system of the Edgeworth Water Company, about five gallons a minute; but the pipe leading down the hill and into Leetsdale is probably four or five blocks long after it reaches the bottom of the hill. When I became associated with that waterworks some fifteen years ago I tried to trace the history and it was guaranteed to me by one of the old citizens who lived there that it had been in at least fifty years, now about sixty-five years of service, for a six-inch,

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wrought-iron pipe, working at a pressure not over 100 pounds to the square inch. That may be a sort of guide to you fellows who want to know the life of a wrought-iron pipe, yet you must consider the quality of the pipe. I have seen pipe made in later years that has been in service less than 10 years that is not in as good condition to-day as this one.

That we may not get away from the subject of the paper, I want to express my appreciation of this very interesting description of the Pittsburgh water-works. To me the more familiar I become with it the more it excites my admiration. Many times I have wished that the citizens themselves could appreciate the plant that we have in this city. We hear of the city built on seven hills, and I noticed a paper recently by some lady stating that Pittsburgh was built not on seven hills but on seventy-seven hills.

I had nine pumping stations in mind. With those nine pumping stations and as many hills as there are, and with the series of reservoirs and tanks, I feel sure that the citizens of Pittsburgh do not realize what a job it is and what careful attention it requires for constant maintenance of the pressure at the spigot in all their houses. That is, of course, but one of the problems for the waterworks man.

The reason I mention this is that to my mind the citizens never think of the cares of their public servants. We often see the lights go out in our houses. On the other hand, we always expect the water pressure to be available and, as far as my experience has gone in Pittsburgh, we have always had that water at the spigot. That doesn't just happen. It is there because such men as Mr. Lanpher and his assistants are always on the job.

I want to mention especially the phase of this work which is under the direct care of Mr. Drake. I was exceedingly interested in his figures and diagrams, some of which I had seen before, but many of which I had not. He has shown the progress that is being made there with regard to the death rate; and, again, that does not just happen. It results because the men are on the job. Not only are they on the job, but they are living their job. I suppose you would find that those fellows would talk shop. Recently I read an article by our famous Mr. Ford, who said that the man who did not live his job, who did not talk shop, really was not the man for that job. Now, it is true in my experience that these faithful servants of the Pittsburgh

Water Department are living their jobs and I have found that they talk shop, and I think the people of Pittsburgh should feel quite safe and should highly compliment themselves that they have men of this caliber running this department.

I have very great pleasure in moving a vote of thanks to these gentlemen for these very interesting papers.

G. E. FLANAGAN:* I should like to ask the author of the paper several questions which appear to be of general interest. There is an impression that what is now Lake Carnegie was originally a half-way station for pumping from the river up to the Highland reservoir in two stages. If that was the intention, I know it was never carried out. Secondly, a word as to the nature of the conduits taking the water across the river from Aspinwall to the city and on over to the South Side. Are these conduits laid on the river bottom, or buried beneath it? Third, I remember that the reservoir at Bedford Avenue used to have a pumping station there with what seemed to be a long-stroke pump. I would like to ask if water was pumped from the Bedford Avenue reservoir to some higher site.

Then, I would like to say, as to the remarks of the last speaker, that we are all so used to the wonderful water service we get that we seem to take everything of that kind for granted the same as the rainfall and the sunshine. The service is so constant and so good that we take it as we do the gifts of nature, and we never stop to think of what is required to work it out.

E. E. LANPHER: As the two reservoirs, Highland and Brilliant Hill, were nearing completion, considerable discussion was recorded as to the scheme of pumping to them. The work at Brilliant station and each of the two reservoirs had been carried on by separate forces, with little, if any, co-ordination. The result was that the city found itself with Brilliant pumping station equipped with pumping-engines designed for pumping to the Highland reservoir and with no units for pumping to the lower or Brilliant Hill reservoir.

Numerous schemes were suggested to meet the situation. The most promising were (1) to install low-lift pumps at Brilliant to pump to Brilliant Hill reservoir; (2) to pump all water to Brilliant

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Hill reservoir and install at this reservoir pumps to lift to Highland reservoir such water as was required for that higher service; (3) to pump all water to Highland reservoir, by-passing the water required for Brilliant Hill service; (4) to abandon Brilliant Hill reservoir. Any scheme except (4) required an immediate investment for pumping equipment and this, coupled with the fact that Brilliant Hill reservoir and the old "lower basin" at Prospect Street were at practically the same elevation, appears to have determined the abandoning of Brilliant Hill reservoir.

As to the second question. At the so-called "upper works," at Prospect Street—what we now know as Washington Park—a pump was installed and put in service in 1850, pumping water from the "lower basin" to the "upper basin"—now known as Bedford reservoir—and this pump continued until 1893, long after Highland reservoir was put in service.

I remember a peculiar statement appearing in the annual report of 1873, as an argument for the purchase of an additional pumping-engine for this station. It was to the effect that the old engine installed in 1850 was very expensive to operate because it took two strokes of the steam piston to one of the water piston and therefore used twice as much steam as it should. That was written by a very competent superintendent. He obtained the desired engine at once and later obtained another.

A question was asked in regard to the Brilliant suction. Brilliant suction consists of two riveted steel mains, 72 inches in diameter, incased in concrete in the bottom of the river. The river crossing between Highland No. 2 and the North Side systems at Twenty-sixth street is a single riveted steel main, 48 inches in diameter, flanged in 120-foot sections and laid by the diver method in the bottom of the river.

W. C. HAWLEY:* I have very little to say. I think Pittsburgh is to be congratulated in having the organization which it has in the Bureau of Water and in keeping in office continuously such a competent group of men. I think the people of Pittsburgh do not realize, and I doubt if many engineers realize, the extreme difficulty of water service in this district—the great differences in pressure under which

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water is served and, of course, the difficulties encountered in the rivers and in reaching parts of the district to be served. I think Mr. Drake is to be congratulated on the splendid results which have been obtained in the operation of the filter plant under his direction. I confess I am surprised that there is so little typhoid left in this district, because typhoid is not altogether a water-borne disease. I have noticed that in the last five years we have had fewer local epidemics due to milk and due to polluted springs and wells. Of course we do have occasional cases of people who get the infection while bathing in the river. There is not as much of that as there was. Typhoid has been pretty well wiped out in this district.

I should like to ask Mr. Lanpher if, in looking over the records, he has discovered who was responsible for the adoption of the standard by which fire hydrants are opened by turning to the right.

E. E. LANPHER: That was William Atkinson. On a map in his report of 1868 he recorded very carefully two valves that opened the right way in the system as against all the rest that opened the wrong way.

Our main need from the standpoint of waterworks management is a proper method of accounting. The operation of such a large public utility under present accounting methods imposes an unfair burden on the management. I assure you that I can not determine from the records of accountants or auditors the cost of any function of the waterworks. Such functional cost records as we have have been obtained by the better grade of engineers, working overtime and outside their regular duties.

Our greatest problem of the near future relates to the safety or reliability of the plant, and whether it is better policy to enlarge present important facilities or to install parallel facilities even to the extent of duplication. Other cities, faced with the necessity of largely increasing their plants (Cleveland and Detroit in particular) have found it profitable to install duplicate primary works in widely separated locations, either of which would carry the load for a considerable time. This policy, regardless of the high cost, is probably warranted due to the added reliability of the water plant.

In Pittsburgh we rely upon single units in our primary works—one single low-lift station, one filtration plant, and while there are

two primary high-lift stations their work can be duplicated in only a minor degree. This is emphasized at present by the threatened failure of the sole suction main leading from the river to Ross station. We are now spending over $300,000 under an emergency contract in duplicating this suction main. There is only one rising main, a 96-inch, steel, concrete-incased main, running from Ross station to the filter plant. There is only one filtered-water conduit running from the filters to the filtered-water reservoir and only one filtered-water reservoir. It will cost more than $2,000,000 to duplicate these few items, and the wisdom of duplicating such portions of the plant rather than build a duplicate plant is doubtful. It is not so many years since cities expected to be out of water once in a while. That time has passed.

Funds are now available for the building of a duplicate river crossing main under the Monongahela River. Funds are also available for the rehabilitation of Brilliant pumping station. Mr. Shaw's paper before this Society a year ago* dealt with the economic questions involved at this station. Here is an antiquated station with pits 60 feet deep, built for the installation of vertical pumping-engines. Its development with centrifugal pumps driven either by steam or electricity is a very difficult and unsatisfactory matter. The policy to be followed has not been finally determined; it is possible that an entirely new station will prove to be the most economical solution. However, of all our needs and problems, those mentioned and many more, I say unhesitatingly that the most pressing is a real functional accounting system. This need is not peculiar to Pittsburgh; it applies to practically every city with which I am familiar. It is true that most governmental accounting accomplishes mainly the concealment of pertinent facts.

W. C. HAWLEY: May I add just a word. There is a prevailing impression among people in Pittsburgh that there is something about the water—some chemical action—that affects its use, and I am glad Mr. Drake stated just what is done. Only last night, in this room, a well-known attorney in Pittsburgh told me that the water killed the grass. A great many people believe that, and I think we engineers should do what we can to correct that impression.

*PROCEEDINGS, March 1928.