The Montebello Water Filtration Plant I

Clean Water for City & Suburb Alike

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The Montebello Water Filtration Plant gave the Baltimore region national acclaim when it was completed in 1915. It was a significant achievement in both engineering and architectural design. In 1912, engineers began the architectural and engineering plans for the landmark which was a boon to the health and well-being of both county and city residents. Many experts combined their knowledge to design Baltimore’s first water filtration facility, and the facility is still in use today.

The Montebello Water Filtration Plant I in Baltimore is notable in several ways. Locally, as Baltimore’s first water filtration plant, it was a significant accomplishment towards improving living conditions, and it was a cornerstone of Baltimore’s modern water supply. In a larger context, it was part of a nationwide movement to build the first generation of municipal water filtration plants at the turn of the 20th century as a result of the Urban Progressive Era. At the time of its completion, The Montebello Filtration Plant was the second largest of its type in the nation and the most modern. In addition, its attractive architectural design and landscaping was an ideal of the national "City Beautiful" movement, giving it national distinction.

The Montebello Filtration Plant I is one of three major municipal water filtration plants in Baltimore, providing clean drinking water to residents of Baltimore City, and parts of Baltimore, Howard and Anne Arundel counties. It is located in Baltimore City at the intersection of Hillen and Harford Roads, just north of Lake Montebello. It was the first filtration plant in Baltimore and marked the beginning of the region's modern municipal water supply as we know it today. With the completion of the filtration plant and water system, water was piped from Loch Raven Dam on the Gunpowder River (completed in 1914 at the elevation of 188 feet above mean tide), to the Montebello Plant, where it was purified and sent to a distribution system for residents and businesses.

The significance of the filtration plant to both Baltimore City and County cannot be overstated. While there is a demarcation on the map between Baltimore City and County, that line essentially disappears in terms of municipal services. The growth and well-being of the citizens of Baltimore County are inextricably linked to the water system that is run by the City, and the two voices were the same in demanding reforms in the early twentieth century. Not only is the water from these reservoirs and filtration plants what the majority of county citizens drink, but their watersheds provide recreation for city and county residents and visitors alike.

Several factors contributed to the nationwide movement of municipal water filtration plant construction and the innovative designs of the Montebello Filtration Plant: the Urban Progressive Movement, the acceptance of Germ Theory, and The City Beautiful Movement. Each of these independently notable topics occurred toward the end of the 19th century. This article will briefly touch on these topics, and hopefully shed light on how they influenced the construction of Baltimore City and County’s first water filtration plant.

Urban Progressives and City Conditions

With the Industrial Revolution came massive immigration to American cities resulting in a population increase that was neither planned nor anticipated. Baltimore was no exception. Between 1870 and 1900 the population of Baltimore increased from a quarter-million to a half-million people. Even without considering the city's population increase due to annexing parts of Baltimore County in 1888, other factors amounted to about one third of the total. There were immigrants from overseas, an influx of emigrating African Americans from farmlands, ex-confederates from Virginia, and farmers from the countryside all looking for employment in industrializing cities.

Meanwhile, cities were not well prepared for their surge in population and industry. Protective labor laws were virtually non-existent, there were few housing codes, and little-to-no government aid we are accustomed to today. Education was primarily for those who could afford it, while the poor often lived in cramped, overcrowded conditions, and commonly worked long hours in dangerous environments. Slums and tenement houses covered a great portion of Baltimore City.
Compounding the problems was the prevalence of major communicable diseases. The deadly diseases of pneumonia, tuberculosis, typhoid, cholera and yellow fever were common conditions affecting anyone within their reach. With the rapid increase in population, city services were strained to capacity. Proper sewage disposal was unheard of, and clean drinking water was not readily available.

Two of the most dreaded and preventable diseases, cholera and typhoid, commonly spread by food and water contamination, were not well addressed because germ theory was relatively new and not widely accepted by scientists or the public. Although tuberculosis, an airborne disease, claimed a higher death rate (its vaccine was not developed until 1906, and did not come into wide use until the 1920s), typhoid was one of the most dreaded of epidemics.

Germ Theory & Water Supply

The now widely accepted fact that bacterial microorganisms in water and food were the cause of disease was not so evident to doctors or the public, even as late as the 1890s. Prior to the 1870s, a widespread belief was that disease was spread by vapors and atmosphere arising from filth - it was known as the miasma theory of contamination. Even after 1880, when two German scientists working independently of each other identified the typhoid bacilli, there were still those that held fast to miasma theory.4

In Baltimore, the prevalence of belief in miasma theory is reflected in both the water system and city growth patterns. To avoid the conditions of “miasmic” disease, many wealthy and privileged citizens had second homes to escape the bustle of the city; the Estates of Belvedere, Clifton and Montebello are examples. They were built on elevated land far from the more populated areas where the miasmic vapors of the inner city allegedly lingered. Because these estates had their own water supplies which were, for a while, uncontaminated, it appeared to prove the miasmic theory.

Meanwhile, in Europe, evidence resulting from the use of sand filtration to clean and clarify water helped to disprove the miasmic theory. In the late 18th century, before the discovery of bacteria, slow sand water filtration was used on small and large scales in Britain and Scotland with the main objective of removing suspended matter. In the areas where slow sand filtering was used there was a lower incidence of cholera, indicating the disease was directly the result of contaminated water and food.5 Slowly, acceptance of germ theory grew, and author M. N. Baker stated in his book, Quest for Pure Water, that “by the 1890’s even the majority of the skeptics had recognized that, instead of being a mere straining process for the removal of suspended matter, filtration removed deadly germs of disease.”6 Although slow sand filtration was established in England, Scotland, and parts of Europe, no slow sand filtration type plant existed in North America before the Civil War.7

Turning Points for Germ Theory in America

With many cities looking to improve water supplies in the 1890s, city planners and engineers debated the best methods to accomplish their goals. The turning point in convincing Americans to use filtration plants for combating disease came in 1893, with the Lawrence experimental station on the Merrimac River in Lawrence, Massachusetts. The State Board of Massachusetts established the station in 1887 to study water and sewage treatment in order to give advice on water supply and sewerage.8 Lawrence was one of the cities that had high typhoid rates (4 times the amount of the rest of Massachusetts due in part to upstream pollution).9 The results of tests and experiments were put into practice by the building of the Lawrence Filter Plant in 1893. After the plant went into operation the rates of typhoid were markedly reduced.10 Allen Hazen, Chief Chemist at the Lawrence Station of the Massachusetts Board of Health, wrote the first treatise on water filtration in connection with public health. It was based on the experiments and successes at Lawrence and also a study of plants in Europe. It was published in 1895 and had a convincing affect on skeptics of germ theory while promoting the positive effects of filtration.11 Improvements were developed, and several years later, in 1895, the Louisville Water Company, and its Chief Engineer, Charles A. Hermay, set up the station to test a new type of sand filtration on the
turbid Ohio River called mechanical or rapid filtration. George W. Fuller, Chief Chemist and Bacteriologist, conducted the tests under the direction of Hermann from 1895 to 1897. In 1897, George W. Fuller published results of the experiments in a report which became a landmark document on the new mechanical method of filtration.\textsuperscript{12}

These two new alternate methods of water purification - slow sand filtration and mechanical sand filtration - emerged as the most recommended for large scale use. Both factored into the decisions made in Baltimore. As more experiments were made, experts eventually favored one over the other given the conditions of the water to be filtered and their own individual experiences with each.

The two filtration processes required building two different types of filtration plants. Slow sand filtration used a combination of settlement techniques and filtering. Water was held in a settlement basin then strained through layers of sand. The rapid or mechanical filtration method was similar except that the filters were cleaned in place by backwashing them with a special process. This occurred several times per hour. This meant that all the filter beds were in continuous use and could process more water in less time.

As cities looked to improve living conditions, confidence was simultaneously growing in the use of water filtration as a method of large scale purification. Experts such as James Kirkwood, Allen Hazen, Edmund Weston, and George Fuller and their associates published important developments in the field and shared them in American Water Works Association (AWWA) and American Society of Civil Engineers publications. Two of the major pioneers in water filtration, Hazen and Fuller, along with their associates, had a direct influence in Baltimore.\textsuperscript{13}

**City Planning and the City Beautiful Movement**

New attitudes towards municipal roles in the urban environment developed. In the same year the Lawrence, MA water filtration plant went into operation, creating a turning point for germ theory, the World’s Fair of 1893, in Chicago, provided inspiration to leaders for planning in cities by revealing how beautiful and functional planned cities could be. The World’s Fair “White City” was landscaped by the famous Fredrick Law Olmstead, and it was served by coordinated public utilities. It was one of the first examples of a planned city, completed with the collaboration of both architects and landscape designers working towards a unified result. It made a lasting impression on visitors by showing what could be achieved by broadening the scope of architectural planning. For many visitors, the fair was a stark contrast to the urban environment they left behind.\textsuperscript{14} As they returned home, many thought of how similar improvements could be adapted to their own cities. It became important that the buildings of municipal utilities be attractive, have a pleasing design, and work well with an overall city plan. Thus, the City Beautiful Movement was born.\textsuperscript{15}

For Baltimore, it was at the right time. The new charter of 1898 helped pave the way for city improvements after the defeat of machine politics and the beginning of good government in Baltimore.

The principal progressive organization in Baltimore that first adopted the City Beautiful ideal was the Municipal Arts Society. Theodore Marburg, a millionaire on the Social Register, started the Society in 1899.\textsuperscript{16}

At first, the society sought to improve the image and sights of the city by erecting statues and murals on public buildings. They were also influenced by Europe and the planned organization of cities there. They sought to group like buildings together, make more city squares and greenways and large landscaped parks and reservoirs.\textsuperscript{17} Democrats
outnumbered Republicans but there was a diversity of religious and ethnic backgrounds. Eighty eight percent of the society was on the Social Register.\(^\text{18}\)

As its first major undertaking, the Municipal Society developed two committees. One was to study the reports of the sewerage commissions under Mayor Latrobe in 1881 and 1893. The development of a sewer system had been held up by partisan politics, and plans ironically languished under good government proponent Mayer Hayes, who was busy with balancing the budget and institutional reorganization. With Senator Gorman, of the Gorman-Raison machine, still in office, events evolved where suspicions grew amongst the organizers. They could not agree on the composition of the Sewerage Commission that would supervise construction of the sewer system. It was the intent of the Municipal Arts Society to look at the study with a bipartisan committee approach to help overcome this partisanship. Its report and findings on sewerage treatment eventually helped enable Baltimore to get support for funds to construct an effective sewerage treatment and disposal system under later administrations.\(^\text{19}\)

The second committee studied and proposed plans for Baltimore City's annex of Baltimore County in 1888. They believed that planned development would be cheaper than rebuilding urban sprawl in later years.\(^\text{20}\) In 1902, the Society engaged the famous landscape architecture firm of Olmstead Brothers to draw up a plan for park and suburban development. The Society believed that intelligent planning was important for functionality and attractiveness of a city.

Fredrick Law Olmstead, famous for the design of the fairgrounds at the 1893 World's Fair in Chicago, New York's Central Park, and planning the Capitol grounds in Washington D.C., was no longer active in the firm, but his two sons carried on his traditions. Fredrick Law Olmstead, Jr, took on the project for the annex.\(^\text{21}\) The plan called for new small local parks and squares, large wooded parks on the outskirts and landscaped parkways radiating out from the city. He proposed adding to the existing Montebello, Druid Hill, Wyman, Clifton and Patterson Parks.

Olmstead also suggested acquisition of “outlying reservations” in anticipation of future growth along Back River, Loch Raven, Patapsco River, Curtis Creek and Green Spring Valley. He called for acquisition of 2,600 acres. Taking advantage of hilly terrain and streams he proposed parkways and scenic drives along Herring Run, Gwynn’s Falls, Stoney Run, and Jones Falls.\(^\text{22}\) The survey and proposal would factor into Baltimore’s water supply future, in both planning and design philosophy.

Applying the Progressive Era’s long-range City Beautiful and planning concepts in Baltimore was in sharp contrast to the city’s early history in water management.

**Baltimore’s Early Water History**

Early in Baltimore’s history, the city relied on a system of wells, springs, piping and small reservoirs owned by The Baltimore Water Company (incorporated 1804). Wealthier citizens had better water sources than the poor.\(^\text{23}\) Water was piped to the more expensive townhomes, while lower classes in the inner city had to walk blocks to get water at springs and wells. This contributed to the incidence of disease and lack of cleanliness for low-income, inner city residents.\(^\text{24}\) In 1852, government officials determined it was best for the city to have control of the water system for the public good. In 1853, the city bought The Baltimore Water Company and all the associated water rights.\(^\text{25}\)
After commissioning two separate studies that examined the upper Jones Falls and the Gunpowder River as new water sources, the city decided on the upper Jones Falls. Although the Gunpowder River was a better source because of its volume and cleanliness, the city chose Jones Falls because of its lower construction costs.

After the city chose its new water source, it developed its first public water utility, which included a dam on the upper Jones Falls - named Swann Lake, and later renamed Lake Roland - that it completed in 1861. A conduit, 5 feet wide by 6 feet tall and 4 miles long, connected Lake Roland to a new reservoir in Hampden.

Two more reservoirs were completed to augment the system: one called Mt. Royal Reservoir, and the other was Lake Chapman, completed in 1870 (now Druid Hill Lake). This public water utility was the first major effort for public municipal water distribution.

However, while the dam, pumping station and connecting pipes allowed the mechanics for indoor plumbing, there was still no sewage treatment. Sewage and waste from the residences and factories lining the lower Jones falls was flushed into the stream, compounding problems. In addition, a large amount of sewage was simply directed into cesspools, which quickly became over saturated and problematic.

By the turn of the 20th century, the lower Jones Falls was still an open sewer that emptied into the harbor. Limited piping also enabled approximately half of Baltimore’s citizens to get drinking water from the facet, though often times it was muddy and impure. Lake Roland often silted up, and many times could not make it through a drought. With dirty, bad tasting water, citizens still preferred the wells and springs, some of which were contaminated with ground water containing sewage and microscopic bacteria.

Due to the slow moving and muddy nature of the Jones Falls and the pollution along its banks, the waterworks at Lake Roland quickly proved inadequate, and it was obvious an additional and better source of water was needed.

In 1874, the city granted authorization to build a dam on the Gunpowder River as a cleaner, more prolific source of water. It was completed in 1881 and included a gatehouse and conduit to a new reservoir, named Lake Montebello. The conduit, 7.5 miles long and 12 feet in diameter, ran straight through solid rock from Loch Raven Dam to Lake Montebello.

Later, because of increased demand, the city purchase land from Johns Hopkins University in order to build a reservoir at Clifton Estate. Clifton was put into service in 1888. Although some water clarity was achieved by settlement in the new reservoirs, there was no way to ensure bacteria were not contaminating water. Nevertheless, both gravity-fed water systems – the Gunpowder River and the Jones Falls - were in use in 1888.

Despite the increased water supply achieved by using both systems, the improvements could not keep pace with the growth of the city and the increased use of water due to indoor plumbing. A larger municipal water supply and filtration system to handle future metropolitan growth was becoming the obvious solution for reliable clean water.

Baltimore’s Decision for Water Filtration

In addition to Baltimore’s troublesome early water history, City Beautiful, progressives, and germ theory impacted the design of Baltimore’s water supply in several ways. On the aesthetic level, planners placed more emphasis on parks, natural landscaping, and beautification and appeal in public buildings. It also became evident that by the turn of the century Baltimore needed to enlarge its water supply and build a filtration plant in order to improve health and living conditions of residents of Baltimore City and County. The need was, in part, due to annexation, population increase and demand for better services.

Planning the city's annexation of parts of Baltimore County included calculating the effects on the supply of water and sewerage to the residents of Baltimore County. Baltimore City provided services to surrounding counties such as water and sewer even though they were paid by city taxes. Just before the city’s annexations of 1888 and 1918, when parts of Baltimore County were incorporated into the city, neighboring counties increased their demand for city services. Plans for these services
had to be made by the city government. Science aided city planning when news of new developments in health and engineering at Lawrence, Massachusetts in 1893 provided fuel for reformers to push for water filtration as an answer for pure water and better health for Baltimore. These changes did not come quickly. The urging for a filtration plant was started as early as 1901 by reformers, and the plant was not built until 1915. This seemed to be the result of delays and lack of consensus for the adoption of water filtration for purifying water until it was an obvious solution. Environmental factors and political factors had an effect on the timing of decisions.

Early on, Baltimore officials debated the need for filtration. A factor in the debate was the cost of building such a plant. Health officials recommended filtration only to be opposed by water officials.

A Baltimore Sun report in 1901 highlights the diligence needed to keep the water supply clear of disease, and simultaneously the resistance to any change:

The statement of health officials that much of the typhoid fever in Baltimore is due to the unfiltered water supply of the city is vigorously combated by the Water Department... ‘Secretary James J. Rood, of the Water Board, in speaking of the matter yesterday, said: ‘under present conditions a filtration plant in this city would not be justified. Every case of typhoid fever is reported to this department, and each case closely watched by our inspectors. When necessary we have the drainage of the house where the patient is changed and take every precaution to prevent the drainage going into the lake. The water is not polluted and there is no need of filtration.”

In 1904, several events provided the impetus to build a filtered water supply. One of them was the adoption by the city of most of the recommendations by the Municipal Arts Society for the sewer and parks plans. The other was the great fire of 1904 and the formation of the Public Improvements Conference in efforts to rebuild.

On February 2, 1904, the City Council passed a public improvement loan and adopted the original recommendations that the Municipal Arts Society proposed in 1902 for the parks system and sanitary and storm sewerage with a few modifications. Although further enlargement of water supply and drinking water filtration was not included in the public improvement loan, the passage was a step towards the goal of City Beautiful and the foundation of the park system that would accompany a modern water system. When the great 1904 fire occurred several days later, destroying most of the business district of downtown Baltimore, the leaders of the community hastened the previously agreed plans into action. With a lot of buildings destroyed, the city was determined to rebuild, and with it came the opportunity to lay underground water, sanitary and storm sewerage pipes, and to modernize the system. A plan under Mayor McLane was proposed for rebuilding the burnt district. There was a disagreement on how the improvements should be accomplished. This slowed organized and coordinated rebuilding. Under Mayor Timanus (Republican) the political partisanship in the wake of the fire was ameliorated by the formation of the Public Improvements Conference in December 1904.

In the end, the burnt district was rebuilt with private money. In 1908, the Public Improvement Conference was continued under Mayor Mahool (Democrat). And, a $5,000,000 water loan was passed by the legislature and the bond issue passed by the voters. In 1908 and 1909 several studies by consulting engineers were commissioned under the loan.

The firm of Freeman and Stearns investigated the best possible ways to enlarge the water supply. Consulting engineers, Hazen and Whipple, studied the best method for water purification. The recommendations by Stearns and Freeman included building a high dam on Gunpowder Falls, one-half mile upstream from Ravens Rock, with a new tunnel connection to the preexisting Loch Raven-Montebello tunnel at the preexisting Loch Raven Dam. They recommended that the dam be designed to rise to an Elevation of 237 feet, the Lake Roland Reservoir be discontinued, and a filtered reservoir and filtration plant of the slow sand type be built.

Hazen, one of the pioneers doing work at the Lawrence, MA experimental station, was a proponent of the slow sand filtration method. In his report, Hazen recommended that a coagulation and
sedimentation basin be constructed at Mine Bank Run and that a slow filtration plant with a capacity of 120 million gallons be constructed at Montebello. The operations at the Mine Bank Run at Gunpowder would partially clarify the water where it would go through the Montebello tunnel to the proposed slow sand plant at Montebello.

The Citywide Congress - “Baltimore, 1920”

In 1911, public support increased for improvement bonds as the progressive movement broadened. The movement undertook more specific public health issues and the issue of water filtration was being raised. The momentum spread to include broad nonpartisan support across various professions, age groups and socio-economic classes. This new support also extended beyond Baltimore City boundaries. Civic Groups in Roland Park, Towson and other parts of Baltimore County formed with the same ideals. Various supporters also supported different reform issues, a myriad assortment of civic groups were working on education, housing, schools, roads, parks, labor issues, children's issues and health issues. In 1911, a Citywide Congress was formed "to discuss ways of furthering good government, equitable taxation, planned public improvement, and social reform. Their goal was to make the best possible city for both rich and poor, and their motto became, “Baltimore, 1920.”

Muddy Waters

The summer of 1911 seemed to be a pivotal time in the developments for the water supply. The Progressive's Citywide Congress was held, and plans for improving the water supply were debated behind the scenes. Other events that summer brought the issue to a head.

On July 18, 1911, the public was warned muddy water would be supplied to residents instead of clear water. Because the water was low in the storage reservoirs, water from the Gunpowder had to be used which was muddy due to rains. The standard procedure of operating the water system in times of heavy rain was to prevent the turbid water from the Gunpowder and the Jones Falls from going to the distributing reservoirs until the conditions improved. In the past there was enough clear settled water in Lake Montebello, Clifton and Druid Lake to supply the city until the conditions subsided. However, with increased usage of the water system combined with the duration of the rains, the city had no choice but to release the muddy water into the reservoirs. City Water Engineer, Alfred Quick, promised the situation would improve, but the public grew more discontented and returned to the old wells and springs for water. The Sun reported conditions in the city on July 29, 1911:

When darkness fell last night, there was a string of men, women and children three blocks long, stretching back from the old spring down near the Pennsylvania rails road tracks at the Harlem Avenue crossing. And these persons were patiently waiting for their turn to get water.

At every spring in Druid Hill Park, at the spring in Wyman Park, at all the springs, in the sparsely settled portions of the city, at manufacturing plants and at breweries where there are artesian wells, folds were massed almost by the thousands.

They carried buckets; they carried bottles, wash basins, coffee pots and tea kettles. And, that they might not take advantage over each other, policemen were stationed almost of the springs in Baltimore. There is plenty of water, but it is muddy and it smells. Without any agitation, without any preconcerted move, the inhabitants of Baltimore decline to drink the cloudy, odorous fluid. Those who can purchase pure water are doing so; those who cannot buy are hunting up available springs and are carrying home enough clean water to drink and to use in the cooking.

The trouble seems to be in the lack of storage facilities. The lakes and reservoirs went short on sparkling water about the same time. There were heavy rains which swept muddy stuff into the streams and this in turn had to be sent into the city mains without waiting to settle. Decomposing vegetable matter got into the storage lakes and this furnished the smelling qualities.
The muddy water continued through the summer. On August 4, 1911, as the issue of muddy water persisted, there was a run on available filters for purchase from dealers, like those consisting of filter paper used with charcoal and other elements: “all kinds of filters are for sale, costing all the way from 5 cents to $100 for one. The patent filters, which screw on to faucets, are of various devices. One that is highly recommended works by water being force through influorial earth which absorbs the impurities.”

Meanwhile, others were profiting on the sale of questionable spring water:

Hundreds of small boys are reaping a harvest. Along the road leading to all the public springs is a never ending procession of all kinds of vehicles. Baby carriages have been sacrificed to obtain wheels for water wagons. The origin of the hundreds of suspicious-looking gallon jugs and bottles is a mystery.

In July of 1911, the Sun reported that Engineer Quick said some of the bad taste may have been due to the water treatment as directed by the health department. (As of January 1911, the city had started purifying the public water with calcium hypochlorite and alum at Lake Montebello, Lake Roland and the Gunpowder.) Although this water was purified from most harmful bacteria before the water filtration plant was put in service, it was still foul tasting and had a bad appearance compelling the public to return to the potentially harmful water in wells and springs. This water treatment was continued until 1915 when the new filtration plant went into operation.

Whether the water crisis had a direct effect in the timing of authorities’ final decision for how to proceed with the water supply is unknown, but it certainly put pressure on officials to make decisions.

Mayor James Preston took office in May of 1911, and by September he made many new appointments in his administration, replacing some of the prior heads of divisions. One change was that Alfred Quick left as Water Engineer. Mayor Preston appointed Ezra Whitman to the position of Water Engineer and Water Board President. Plans and contracts were drawn up for awarding the construction of the dam, filters and piping, and put under the authority of the Gunpowder Improvement Division.

The decision on the type of water filtration was reconsidered and it was determined that another opinion should be obtained on the type of water filtration to be used. The results at the experimental water filtration plant built in late 1910 suggested that there would be a problem with the slow sand filtration method in muddy conditions. In response, the Water Board began to doubt the recommendations of its consultants, Stearns and Freeman, and Hazen and Whipple, on the slow sand method.

In April of 1912, the Water Board, and Water Engineer, Whitman, appointed by the Mayor, called in more experts to study the water. One of the foremost experts in the field at the time was George B. Fuller. Fuller had recently left his firm with several other associates to do independent consulting work in 1911. When he came to Baltimore, he brought his associate in the firm, James W. Armstrong, who was an expert in the water hydraulics and filtration. It was evident from the report that the crisis of the muddy water in 1911 was one of the reasons to reconsider the filtration method.

Fuller evaluated the advantages and disadvantages of slow sand filtration and mechanical filtration types based on both Hazen’s prior study and new developments in the field. Fuller cited success of large completed filtration plants that use the mechanical method of filtration in Harrisburg, Cincinnati, Columbus, Louisville and New Orleans. In conclusion, he states:

Taking into account all of the data bearing upon the filtration of the proposed new water supply from Gunpowder river, at Loch Raven, I conclude, without any qualifications whatever, that a mechanical filter plant located either in the valley of Mine Bank run or near Lake Montebello when well built and well operated, will give a thoroughly satisfactory quality of filtered water, hygienically and with respect to appearance, tastes and odors, and its effect upon the distributing pipes; that its results will be fully equal to those which would be secured by a first-class sand filter plant; that it will be somewhat more manageable than a sand filter.
plant when treating the varying conditions of water which will be drawn from the new impounding reservoir; and that the cost will be less.

I recommend the adoption of a mechanical filter plant, with all necessary appurtenances for the treatment of the future water supply of Baltimore.48

The Water Board adopted the recommendation. A Filtration Division was formed. The board hired James W. Armstrong to design the plant and head the Filtration Division. Then, the city also hired Fuller as a consultant.49

James W. Armstrong, Master Builder

James W. Armstrong’s prosperous career is indicative of nation-wide initiatives to provide clean water to all Americans. Armstrong was a water filtration engineer with an eye for architectural design in an age when aesthetics and functionality were equally important. He was born in 1868 and was a contemporary of both Wilbur Wright and George Fuller. His birthplace was Illinois but he grew up in Cedar Rapids, Iowa. He began his career as a draughtsman in a small firm in Iowa and soon was working on a railway project as assistant engineer. He then went to Central City, Kentucky to work for Thomas Coleman DuPont, most likely in connection with coal mining there.50 By 1893 and 1894 he was enrolled in University of Chicago, taking courses in engineering, drawing, sanitary construction, theoretical and applied mechanics, wood construction, bridge analysis and architecture.51 The Army Corps of Engineers believed Armstrong may have been a student of the pioneer architectural educator Nathan C. Ricker:

It is possible that Armstrong’s courses in architecture were under the direction of Nathan C. Ricker, who was one of the pioneer architectural educators in the United States. Ricker modeled the second American Architecture program in the United States not on the French Beaux-Arts or fine arts system, the source for most other schools, but on the German polytechnical universities with their inclusion of architecture in a an engineering curriculum and an emphasis on technology. Although the source of Armstrong’s design ability is unknown, the time he spent at N.C.Ricker’s architecture and engineering school, even at the advanced age of 26, must have been important.52

It is unknown whether he attended the Chicago World’s Fair, but he was likely influenced by its concepts, planning, and the attractive layout of its buildings. The Ricker school of design used thousands of blueprints and a complete set of structural drawings from the 1892 World’s Fair as part of its educational materials.53 In 1899, Armstrong was employed by the New Orleans Sewerage and Water Board. There, he worked his way up from draftsman and was thereafter given charge of the design and construction of the water filtration plant in New Orleans under the supervision of Superintendent George G. Earl in 1906.

James Wadsworth Armstrong, c. 1930. (Photograph in possession of the author.)
Armstrong was put in charge of pumping, power and purification plant design because he had “the proper combination of experience in steel structural work and of taste in color, form and appearance to undertake this part of the Board’s work....” The massive project in New Orleans addressed the difficult problem of providing service to a city below sea level. It encompassed providing a sanitary sewerage system and also a water supply system. As engineer in charge of the water filtration plant Armstrong had knowledge of engineering and construction, and the ability in architectural design of a master builder. The plant was completed in 1908, and is still in use today. All the buildings for the works of water filtration, pumping stations and sewerage pumping stations constructed before 1908 are his architectural style. The plant became something of a tourist attraction and was featured on many post cards.

Armstrong then did consulting work in Chattanooga Tenn., after which he went to New York, joined the firm of Hering and Fuller and designed plants in Montreal Canada, Grand Rapids Michigan, and Minneapolis Minn. Sometime in 1911, Fuller, Armstrong, Harding, and McClintock left Hering and Fuller firm to form their own partnership.

When Armstrong came to Baltimore, he was working with Fuller. In 1912, the water board adopted Fuller’s Report, formed a Filtration Division and hired Armstrong as engineer of the division. Fuller was retained as a consultant. In reference to Armstrong, the Report of the Water Board of 1912 states, “we feel that the city has been very fortunate in securing the services of so experienced a man to take care of this important part of the new improvements to the city’s water supply.”

1912 - Planning Begins

In the month of July 1912, a year after the muddy water crisis, Armstrong came to Baltimore and inspected the water with Engineer Whitman. Whitman was the Water Engineer and President of the Water Board appointed by Mayor Preston. He oversaw the massive Gunpowder project as a whole, including the work of the Filtration Division, the Gunpowder Improvement Division that included the dams and piping and how they coordinated together. Armstrong, as head of the Filtration Division had complete charge of design and construction of the filtration plant. The Sun reported on Armstrong’s inspection in July 1912:

‘In some respects,’ Mr. Armstrong said. ‘Conditions here are somewhat similar to those which existed in New Orleans where I had charge of the designing and construction of the filtration plant. There the water was muddy, very much like that in Baltimore, and we had many other conditions similar to those we will have to contend with here. The New Orleans plant was not quite so large as the one proposed in Baltimore, although the conditions were more complex.’

In July, 1912, Armstrong and his team began detailed plans for the new plant. The Sun article reported, “it was necessary to make a complete new study of the situation before anything could be done.” The designs, drawings and specifications were made by Armstrong and his team for awarding of contracts that began in 1913.

The site of the plant was of prime consideration, not only for functional reasons, but also aesthetic reasons. Of the two sites originally suggested for the filtration plant, Mine Bank Run - near Loch Raven - and Montebello, Montebello was chosen for its beauty. In the Filtration Division’s Report of 1912, Armstrong detailed why: “Every advantage was in the site at Montebello... Montebello is an exceedingly attractive spot and the topography is such that the grounds around the filters can be parked and made particularly pleasing.”

Plans for the mechanical filtration plant consisted of a group of structures. The head house contained the offices and labs for water testing. The tower of the head house was the intake point of where chemicals were delivered and stored. The coagulating and mixing basins, open to the air, were where the coagulating chemicals hypochlorite of lime, and sulphate of iron were mixed with water to promote flocculation, or “floc.” They were stirred in large circular vats until floc was formed. (Floc was the process by which smaller particulate matter bound together into larger particles.) The water then
went to the settlement basins after which, some of the larger particles were skimmed off. The water then went to the sand filters that were housed in a long covered building attached to the head house. A long passageway called the “filter gallery” allowed walking to and through the filters. The water was strained through the filters which were composed of various grades of gravel and sand, and the finished water beneath piped to several large underground reservoirs. Final sterilizing chemicals of hypochlorite of lime were added to the finished water before it was distributed. Then, several times an hour, the filters are ‘backwashed’ so that the top sand layer, called the ‘dirt cover,’ is cleaned and carried off to the aerated wash water pond. Debris settled in this pond and then clean water flowed off at one end into a stream. The wash water building was the structure that held water for use in backwashing. Two more important structures were the pumping station and the aerator tower. The pumping station was situated directly over the raw water intake from the Gunpowder Montebello tunnel. It housed pumps which were necessary before the dam was raised to the highest elevation (in 1923) in order to increase the pressure going into the Filters. It was also needed in case of low water levels at Loch Raven. The aerator tower was designed to aerate the water before filtering so that it tasted better. The design and grouping of these structures in the landscape was carefully considered to create a pleasing effect.

Construction on the Montebello plant began in late 1913 and took 2 years to complete. Photographs show the enormity of the work. The land was in farm country, just north of Lake Montebello, and it had several houses and barns on it. Some of the barns were used to house the horses used on the construction sites. Several of the houses had to be moved or razed. Several houses were saved and refurbished for resident personnel who worked at the plant. One of the houses was refurbished for the Filtration Engineer who ran the plant. The work on the resident engineer’s house began in 1912 and finished by the start of 1913. Besides the pipes that had to be brought in to the point of where the plant would stand from the existing underground water tunnel, a wash water lake with an earthen dam was built using horse power, steam shovels and a short railway for moving dirt. The railway ran the length of the construction site from the dam to the filters and (an extension of a street railway track from Harford Avenue). The railway was also used to bring in filter sand.

There were problems near the start of the project. In 1913, contractors were working on contract no. 4, the filtered water reservoir. The contract was awarded November 1912, but preceded at a slow pace. Armstrong cited in the filtration division section of the Water Report of 1913, that when the contract time had expired, only 66 percent had been completed. Not enough workers were on the job. In addition, no allowances were made in the contract for encountering rock, and, “a considerable amount of rock had to be blasted.”

There were also problems with the groined arches of the reservoir. In October 1913, the underground arches failed and it was found that the failure was not due to design but to premature loading of the soil over the arches that cause the failure. The piers and arches were replaced and repaired as needed.

To compound the problem, the contractor for the underground reservoir was in the way of the other contractor for contract 11, which encompassed the filters, basins and grading scheduled to work on their phase of the project. The report states, “Unless their work is pushed with unusual vigor in the spring, it will cause a serious delay in the completion of the plant.”
As the plant neared completion in 1915, anticipation was building for its opening day. The press reported the benefits and features of the new plant, some of which were detailed in *The Municipal Journal* in March 1915:

> The place selected is a very beautiful one and is in many ways an ideal spot for the location of a filtration plant. In fact there are few if any filter plants in the country so fortunately situated. The ground upon which the buildings stand is high and they can readily seen from a considerable distance. It has therefore, been the effort of the designers to make the plant as pleasing in appearance as possible. The buildings are constructed of dark red brick trimmed with buff terra cotta and covered with green tile roofs. The grounds are to be beautified and the whole plant maintained in harmony with the park by which it is surrounded.\(^70\)

The article went further, describing the rapid filters and the fact that they processed water at 20 to 30 times faster than the slow sand type. It also commented on the large size of the plant, having 32 filters, combined with its modern construction of reinforced concrete, use of hydraulics to operate filter controllers (rather than manual operation), and its use of electricity for the pumping station (instead of steam power).\(^71\)

On April 23, 1915, officials estimated the plant would be completed in two weeks, but not in service until late summer. Filtration Engineer Armstrong explained that the filters needed to be tested before being put in service.\(^72\) Armstrong and the other engineers experienced great pressure to have the plant completed before May 1, because of the mayoral elections. Mayor Preston promised the public that the plant would be in operation before the end of his term. Preston’s term was due to end several weeks after that.\(^73\) On May 7, 1915, the *Sun* Papers reported that water had reached the plant from the reservoirs for testing the filters, and that they could possibly be ready by July 4.\(^74\) Then, on June 15, the *Sun* reported that the pumps were successfully tested and that Engineer Whitman said that the Plant would probably be ready by the middle of August and that there had been a delay in getting gravel and sand from the contractors for the filter beds. On July 11, 1915, a feature article with a photograph in *The Baltimore News* titled “Big Filtration Plant Nearly Ready, Declared One of the Finest in World,” extolled the features of the plant and Armstrong’s experience in filtration plant design.\(^75\)
In the meantime, the Loch Raven Dam was completed in 1914. The advantages of the new, high dam to the importance and effectiveness of filtration was recalled by Armstrong (with a bit of humor) years later in an article of or the AWWA in 1932:

The river used to be very flashy; one day it would run clear and the next day it might look like mud. Turbidities as high as 5000 p.p.m. have been recorded. Most of the suspended matter carried by the small streams flowing into the reservoir is now precipitated very shortly after entering the larger body of water. As a result the water reaching Montebello is not subject to sudden fluctuations in quality and is much clearer that formerly. The water is much freer from bacteria as greater numbers of them are carried to the bottom of the reservoir with the sediment. In the old days they would have been delivered directly to the consumer without any extra charge.76

Montebello Plant Opens with Ceremony

Opening ceremonies were held during the weeklong celebration of the 100th anniversary of Defenders Day. The event’s publicity emphasized that the grounds of the plant once belonged to General George Smith, and the plant was named after his mansion and estate, Montebello. (The mansion had long been torn down prior to the building of the plant, and was located to the southwest, across Hillen Road.) The plant’s opening was planned months in advance.

There was growing municipal pride in Baltimore after Mayor Preston came into office and thereafter won a second term. The sewerage system had been completed with the pumping station downtown in 1911. The Mayor had formed a municipal band and the Municipal Journal. To top it off, the completion of the filtration plant was a proud day for Baltimore.

The general public was invited to the ceremonies and to inspect the plant.77 Armstrong sent formal invitations with a pamphlet that explained the filters to people all over the country, including to experts and officials in the fields of engineering and waterworks in other cities.78 Two thousand people attended the event.79 Speeches were made under the tent by Mayor Preston, the filtration division, the plant’s designer, James Armstrong, as well as Ezra Whitman, who previously served as president of the Water Board and Water Engineer. (Before the plant’s completion, Whitman left city employment in 1914.80 Later, he formed his own engineering firm in Baltimore.81) Additionally, speeches were made by George Bernard, acting water board president, and by Professor Granville Jones, head of the health department. The municipal band performed and the public was invited to sample the water while they toured the facility.

In his speech, Mayor Preston praised the people responsible. He gave full credit to Armstrong for the design and construction of the plant and asked him to stay on to manage it. While that was the formal announcement of Armstrong’s invitation, newspaper accounts previously hinted he would remain as plant manager, and, in fact, Armstrong and his family already moved into the refurbished engineers house in 1913 so Armstrong could supervise the construction.82

On September 13, 1915, newspapers reported the good news. The Morning Sun’s headline read, “Water Filter Plant Ready:”

Taxpayers who like to see how their contributions to the city’s maintenance are spent will have an opportunity to do so if they are present at 11’ o’clock this morning when Mayor Preston formally turns on the water at the great filtration plant that will henceforth purify
Baltimore’s water supply. A view of this interesting and intricate bit of mechanism will make the taxpayer realize that the $5,000,000 water plant is a big asset and something he can be proud of when telling his friends in other cities of the advantages of Baltimore. The filtered water is now going into every home and the unpalatable water of the past soon will be a memory only.  

Baltimore’s News American reported:

All will see just what has been accomplished and will be about to come to an appreciation of what the filtration of the city’s water means to the health of the of the community…. For a long time strenuous protests have been made by citizens against the sort of water-murky, frequently disagreeable in taste and repulsive in odor-they were forced to drink if they did not feel able to patronize the various commercial dispensers of spring water.

Upon completion, the Montebello Water Filtration Plant became known nationally for its architectural appeal and engineering accomplishments, making it something of a tourist attraction in its early years.

The plant gained the attention and interest of professionals even while it was under construction. Because much of the plant was underground, many of its features could only be appreciated while it was being built. In 1914, Armstrong gave an informative and educational tour to members of the National Electric Association (NELA). The report of the visit in the Baltimore Gas and Electric News explained the features of the plant with accompanying photographs. In 1915, 100 members of the Association of Master Plumbers also toured the works.

Thereafter, the plant was widely featured in professional journals and newspapers. The New York Municipal Journal dedicated a feature article to the plant with pictures and explanations of the works. The Engineering Record featured articles on September 4, 1915, stating the plant “represents some of the latest ideas in filter plant detail and that the city has had fortunate in having an engineer of the caliber of James W. Armstrong to control the destinies of its Lake Montebello water purification project.”

There were many visitors who came to see it from around the country and the world as the years progressed. Professionals in the field of water filtration, public health and engineering who could not attend the opening day ceremonies later visited the plant.

In replies to letters of invitation sent by Armstrong to attend its opening day, many respondents expressed great interest in visiting at a later time. Among the many visitors who did visit later was an engineer in charge of designing a filtration plant for Henry Ford named Mr. Meyers. He asked to visit the plant in order to see the Aeration Tower on February 4, 1919. In his reply, Armstrong offered to go over the plans with Meyers when he visited. The tower had been built, but the operational part of it had not been installed yet, since it was budgeted to be installed at a later date. Then, the manager and chief engineer of waterworks of Hartford, Connecticut visited the plant in March 31, 1919, and was interested in the rapid sand washing. Finally, for many years, tours of the plant were given to school children.

Architecture

No doubt, besides advances in engineering, one factor in the attraction of the plant to visitors was the beauty of the architecture and the landscaping of the grounds. Though the ideal of City Beautiful was evident in the conception of Montebello, the style of architecture did not follow the Beaux Arts style so evident at the Chicago World’s Fair.

Beaux Arts was criticized by many architects as being little more than an imitation of the architecture of Europe, instead of something uniquely American. Architect Sullivan, who departed from the Beaux Arts in his design of the Transportation Building at the World’s Fair Columbian Exposition later wrote that he thought the fair’s architecture was a setback in the advancement of American architecture.

The modern design of Montebello benefitted from Armstrong’s training with Ricker, who also departed from the Beaux Arts style. It followed more closely the ideas proposed by Frank Lloyd Wright and Sullivan.
Armstrong’s design philosophy was revealed through his later writings for the American Society of Civil Engineers. In a section in *Water Treatment and Plant Design* by the Sanitary Engineering Committee, Armstrong contributed a section titled “Design as Affected by the Size of the Plant,” in reference to small plants. He states, “Economy may be secured by the compactness and arrangement of buildings and grouping of all structures so that they are adjacent to one another.” He goes on to say:

…the superstructures of buildings should be studied carefully in order to secure a pleasing appearance by the general arrangement and proportion of the structure, rather than by use of material or details furnished simply for the purpose of embellishment. In the hands of an artistic designer, a beautiful building can be built at less cost than an ugly one designed by one who lacks such ability.93

The architectural style of the plant is sometimes referred to as Wrightian,4 but its mix of styles can be described as Mission Style with Italianate features. The large overhanging eaves, and the way the plant blended with the landscape, along with the head house tower and the aerator tower are Italianate in style.

Rather than trying to copy the style of the original Montebello Mansion that Samuel Smith built on land adjacent and southwest of the Montebello Filtration Plant I, Armstrong decided on a style inspired by both the country that inspired the name Montebello, and Armstrong’s time in New Orleans. Samuel Smith previously named his estate after the Battle at Montebello in Italy. The Spanish tile roofs were a carryover to styles typical of New Orleans where Armstrong had spent the early part of his career, but were also indicative of the Italian villa. (Reference the front cover.)

Two of the most interesting and architecturally significant structures that were part of the original plant, no longer exist today. They are the low level pumping station and the aerator tower. The pumping station sat slightly downhill from the aerator tower. Its function was to pump water from the intake of the tunnel from Loch Raven into the plant in time of low water flow. This was necessary when the Loch Raven Dam was originally built, because it was not built to the recommended 237 feet. Under normal water conditions, with the dams at their recommended height, the gravity fed system would not need the pumping station.

The pumping station was a round brick structure ornately styled with Spanish tile roof. Just below the roof level were wide short windows, a band of plain concrete gave an accent, and around the circumference were brick accent bump outs or columns with tall narrow windows in between. The entrance of the structure was accented by a peak in the accent band and the roof rising slight gable. The arched door was accented by lights on either side. Inside the pump house was the magnificent beauty of modern machinery - a circle of large modern electric pumps all facing towards the center.
Just to the front of the pump house, on higher ground, was the simple but elegant aerator tower. It was tall and square and seems to be Italianate style. Not tall or narrow enough to be like a bell tower. It brings Italy to mind. The brick structure is plain except at the entrance and about the top third is a concrete band accent with elegant open arches, topped by the simple Spanish tiled roof. The same arched doorways with fanlight grace the front with windows on either side. Lombardy poplars were planted around the tower. Taken together, these structures had a beauty and uniqueness all their own.

The filter galleries and the wash water building feature large Palladian windows that let in plenty of light and give an airy classical, but clean and modern feeling.

In addition to the splendid architecture, the grounds were beautifully landscaped with flowering shrubs and specimen trees. Roses, Lombardy poplars, orange blossoms, Japonica, Hollyhocks weeping willow, elm and cedar trees all adorned the grounds, leading many visitors to comment on the overall beauty.

The grounds were expansive and merged into Montebello Park. The plant overlooks Montebello Reservoir. The wash water lake, when it was first built, had a road around it, flowering plants, weeping willows, mowed lawns, and cedar trees. A stream flowed into the pond at one end and the outflow of the pond at the outer end and made its way to Herring Run. Throughout the early part the century it was a beautiful spot, well aerated and available for a pleasant stroll along its banks. A newspaper article featured a model boat club sailing their model model boats on it. The practice was stopped because some visitors had a mind to take a swim. Today, the wash water lake is a wildlife area and inside the fenced enclosure surrounding the plant.

In summary, the completion of the Montebello Plant I was a proud moment for Baltimore City and County, and a significant achievement both locally and nationally. A major plank in the progressives “Baltimore 1920” was achieved. Baltimore, at last, was capable of producing voluminous pure water for its citizens in a system that, by-in-large, is still in use to the present day. The completion of Baltimore's Montebello Plant set a new standard for other large cities, as it had the largest mechanical filtration plant in the world, and exhibited one of the best examples of the City Beautiful ideal, which extended into Baltimore County and the surrounding suburbs.

Armstrong Postscript

Armstrong remained head of the filtration division in Baltimore for 25 years (1912-1937), where he managed the plant and watershed operations. He also completed designs for raising the Loch Raven dam in 1923, designed the second Montebello Plant, found the site for and developed designs for Prettyboy Dam. He studied proposed locations for Liberty Dam and conducted important sand studies. Armstrong also contributed to a booklet published by the American Society of Civil Engineers titled, Water Treatment and Plant Design, that influenced future designs for filtration plants nationwide. He was active in the American Civil Engineering Society. In addition, Armstrong performed studies and formulated a method for manufacturing liquid alum which was used at Montebello Filtration Plant no. 2. In 1937, Armstrong retired, and in 1939 he received the American Water Works Association’s George Fuller Award of the 4 states section (now Chesapeake Section). In the citation there was a special notation
stating, …in making the George W. Fuller award to Mr. Armstrong, it is done for this recent work on sand, and contrary to custom, his outstanding ability in design and construction is also included.”100

Water Filtration Plant, 1915. (Photograph by Alfred Waldeck, in possession of the author.)

Notes

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10 Baker, Quest for Pure Water, p. 140.
11 Ibid.
12 Ibid., p. 228
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90 Ibid.
91 Caleb Mills Saville, Letter, “Visit to Montebello Filters,” March 31, 1919, Board of Water Commissioners, Engineering Department, Pilgard Building, 1026 Main Street, Hartford, CT, (in possession of Martha Hendrickson and Montebello Plant II).
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About the Author

The author, Martha Hendrickson, is the granddaughter of James Armstrong. She has a B.A. in American Studies, with a minor in Art from the University of Maryland, Baltimore County (UMBC), and a Computer Aided Design certificate in Architecture and Engineering from the Community College of Baltimore County (CCBC). She has worked in the fields of both photography and architecture. Martha developed an interest the water supply after she inherited her grandfather’s photograph albums. In her spare time, she is involved in the Maryland Miniatures Unlimited, and has meticulously crafted a model of the Montebello engineer’s residence which has appeared in several exhibits.

You may contact Martha with questions, concerns, and research related to this publication or miniature creations by email: marthahendrickson@hotmail.com.

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Submissions

While History Trails’ subject matter has traditionally focused almost entirely on local concerns, we are interested in expanding its scope into new areas. For example, where one article might focus on a single historic building, person, or event in the county, others may develop and defend a historic argument, compare and contrast Baltimore County topics to other locales, or tie seemingly confined local topics to larger events.

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