SANITATION OF THE CITY OF WASHINGTON.—II.

BY BEN. WINSLOW.

THE SEWAGE DISPOSAL SYSTEM.

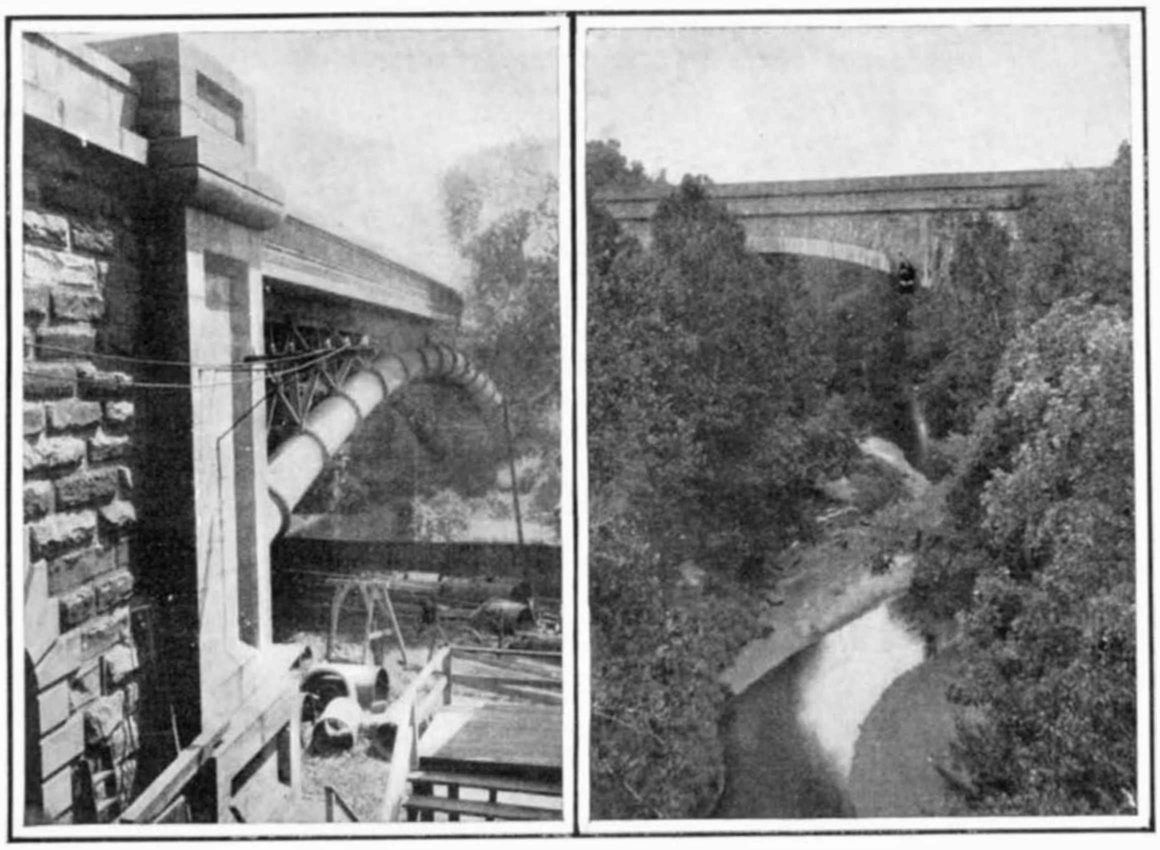
The Washington filtration plant, while of inestimable value in the national capital's fight against a high death rate, was not the first important movement in the campaign. For fifteen years or more the District engineers have been at work on the great sewage disposal system, which it is hoped will be completed next year. Plans for the filtration plant were not considered until several years after work had begun on the sewage system, but, being a smaller "job," it was completed in a comparatively short time.

In 1889 Congress, after going over volumes of figures showing that the high death rate in Washington was due in a measure to the lack of proper sewage facilities, authorized President Harrison to "appoint a board of sanitary engineers to report on the existing system of sewage, and to make recommendations for the extension of the system." The report was made the next year, and work on the recommended plan was commenced shortly afterward. As a result, Washington will have one of the best sewage-disposal systems in the world.

The recommendation of the sanitary board was that all the sewage of the entire city be collected at one point, and then forced across the Eastern Branch of the Potomac River to an outfall sewer, which discharges into the Potomac, several miles below the city. The cost of this project will be $5,000,000. The vital part of this great system is the pumping station—the point of collection—where the entire sewage of the city is raised a distance of nearly thirty feet and forced across the river. For the purpose of collecting the sewage two separate and distinct sewer systems are necessary, one at the usual level and one for the low-area district. The business section of the city, on Pennsylvania Avenue between the White House and the Capitol, is in the low-area district, and on several occasions this section has been flooded by water backing up in the sewers. The most notable flood in the history of Washington occurred in June, 1889, when rowboats were used to navigate the streets in this section. While later freshets were not so severe, cellars are frequently flooded and much damage results.

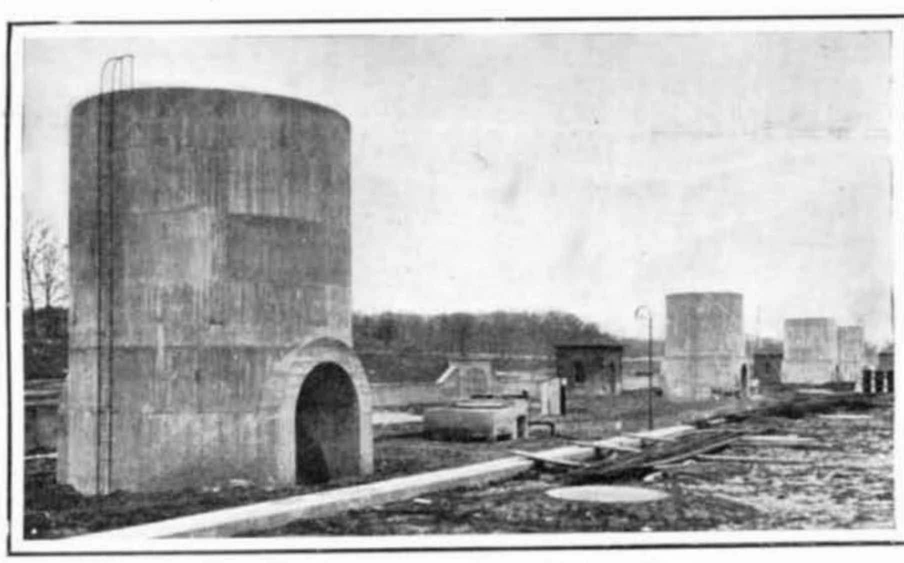
The first system of sewers has as its main feature a great trunk sewer, known as the B Street sewer, varying in diameter from seven to eighteen feet and extending a distance of over two miles. This trunk sewer is fed by numerous high-level interceptors and small conduits. The other system, which collects the sewage from the low-area district, consists of a large trunk sewer running under Pennsylvania Avenue, which is also fed by numerous interceptors and small conduits.

Ordinarily, the sewage from the B Street trunk sewer will flow into a junction chamber in the northeast corner of the pumping station. Here it will be divided by means of gates, and made to flow around a large sedimentation chamber into a screen chamber. In this chamber all the solids will be removed, and the liquid sewage will

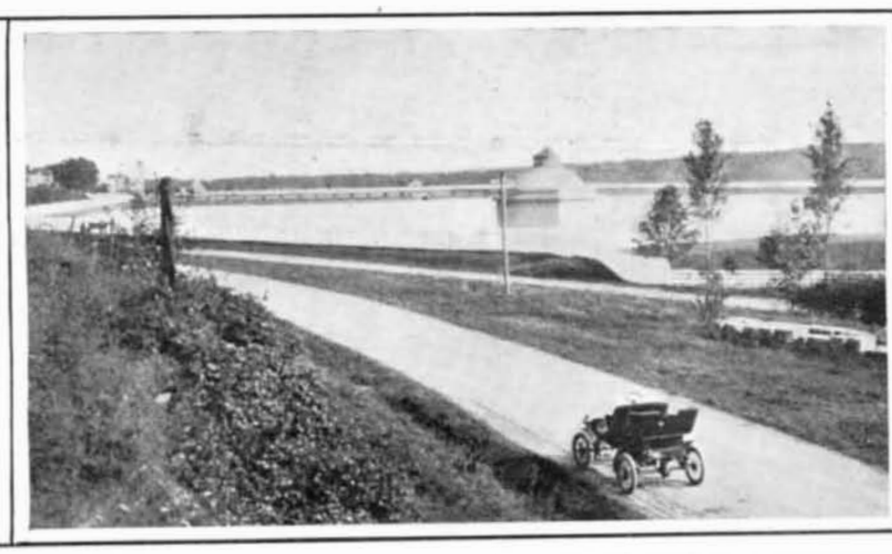


Pennsylvania Avenue Bridge. Cabin John Bridge.

The Washington Aqueduct.



The Sand Reservoirs of the Filtration Plant.



Georgetown Reservoir and a Section of the Conduit Road.

A Panoramic View, Showing Each Stage of the Work.

SANITATION OF THE CITY OF WASHINGTON.—II.

flow direct to the immense pumps which lift it into the siphon chamber. Here gigantic centrifugal pumps will force the sewage across the river through a pair of inverted siphons to the outfall sewer, through which it will flow by gravity to the outlet several miles down the river.

During heavy rainstorms, the gates of the sedimentation chamber will be opened, and the sewage will flow direct into this chamber instead of passing around it to the pumps. In this chamber sticks, sand, etc., will be removed before the sewage passes into the screening room and into the pumps. Should the rainfall prove exceptionally heavy, the storm water carried down in the large sewers will be divided by means of gates, which operate automatically, into four storm-water tunnels on the east and west sides of the pumping station. Through these tunnels the water not handled by the pumps will flow by gravity into the Eastern Branch. As a further precaution against flooding of the low-area district, immense storm-water pumps will be installed, and at the slightest indication of a flood, these pumps will be set to work pumping the storm water out into the river.

The solids removed from the sewage in the screening chamber will be pressed in hydraulic presses and loaded into a train of large buckets. These buckets, which are operated by electricity, run on overhead tracks, and carry their load through a conveyor tunnel extending around the east and west sides and across the north end of the pumping station, to a crematory.

The floor of the pump room is about twenty-five feet below the bottom of the river. In this room there will be thirteen powerful centrifugal pumps. Eight pumps on the west side, each having a capacity of 65,000,000 gallons a day, will be used for pumping storm water. The ordinary sewage from the high-level trunk sewers will be pumped by three pumps, each having a capacity of 65,000,000 gallons a day, while two pumps, each having a capacity of 20,000,000 gallons a day, will pump the sewage from the low-level system. The system has been designed to adequately handle the sewage of a city of 800,000 persons. All the sluice gates, valves, covers, and interceptor gates in the entire system, some of which weigh several tons and all of which are operated by hydraulic lifts, will be controlled by one man in the engine room, whether they are located in the station or a mile away.

The most interesting feature in the construction of this great system was that of laying the twin siphons across the river. Each of these siphons is five feet in diameter and 1,200 feet long. Most of the work was done under water by divers. The siphons were laid in forty-eight-foot sections, four twelve-foot sections being welded together on the pumping-station dock. Each forty-eight-foot section was fastened securely to the top of a fifty-foot caisson, simply an air-tight wooden box, and the caisson was towed into position and tipped over, so that the section of pipe floated under it. Ports in the caisson were then opened, allowing water to flow in, and gradually the caisson with its load of pipe settled to the bottom, where divers guided the section into place and secured it there. One twelve-foot section weighs 14,000 pounds, and the weight of the four sections handled by the divers is about thirteen tons. The siphons are laid on beds of piles driven in the bottom of the river, which has been dredged to the proper depth. From the siphon chamber the pipes go down with a steep slope to a distance of twenty-six feet below the surface of the water, and then rise an equal distance to the other side, where they connect with the outfall sewer in Maryland.

When this immense sewage-disposal system is put in operation in the spring of 1907, the most important work in the sanitation of Washington will have been completed, and the citizens who have been foremost in the enterprise can bend their efforts to the solution of the next important question—the sanitary housing of the poor of the national capital.

AN OFFICE BUILDING 612 FEET TALL—THE LOFTIEST MASONRY STRUCTURE IN THE WORLD.

When the tall office building, in the course of its rapid evolution, had attained the height of 300 feet, it was freely predicted that the limit had been reached, and that future structures in New York city would be of more reasonable vertical dimensions. That prediction was made not much more than a decade ago; and yet to-day there is in course of construction in lower New York a building whose summit will reach heavenward for over twice three hundred feet. The new building, which will be in the form of a tower and will constitute part of an extension of the present Singer building at the corner of Liberty Street and Broadway, will contain forty-one stories, and the top of its cupola will be 612 feet above street level. Not only will the Singer tower be the loftiest inhabited building in the world, but it will exceed in vertical height the famous Washington Monument on the banks of the Potomac, which, with its total height of 555 feet, is at present the tallest masonry structure erected by man. Although the Singer tower will lack some 300 feet of equaling the famous Eiffel Tower, it will be a far more difficult and costly structure to erect, and because of its narrow base will involve more complicated and serious engineering problems.

The new building will form the most important part of an extensive reconstruction of the old Singer building at the corner of Liberty Street and Broadway. Great credit is due to Mr. Ernest Flagg for his successful treatment of this unusual architectural problem and to his engineers for the solution of the constructional difficulties involved in the design of so narrow and lofty a building. An addition to the old structure, with a frontage of 76 feet on Broadway, is to be built on the northern side of the building, and the westerly portion of this addition will constitute the great tower. The original building and the addition will be fourteen stories in height, and the tower will extend twenty-seven stories above this.

Although in plan the tower will measure only 65 feet square, its total uplift is so great that its floor space added to that of the main building will be greater, with a single exception, than that of any other building in New York city, the total area amounting to 9½ acres. The elevator well will be oblong in plan and placed in the center of the building. For the service of the lower portion of the building there will be sixteen elevators, and, as the upper floors are reached, they will decrease in number, until there will remain four elevators for the service of the topmost floors. It is estimated that when the building is fully occupied it will accommodate about 6,000 people.

From a constructional point of view, the most interesting feature of this extraordinary structure is the means adopted in framing the steel skeleton, so that it will resist the enormous accumulated wind pressure, when the thunder squalls of the summer and the heavy gales of the winter sweep over Manhattan. Decidedly interesting also is the method of treatment which has given this tower an architectural character usually absent from our modern "skyscraper." The plan adopted, both in designing the steel skeleton and in the treatment of the exterior, has harmonized both the engineering and architectural requirements of the case. It was realized that, in order to obtain sufficient strength to resist the enormous transverse bending stresses due to wind pressure, it would be necessary to introduce diagonal wind bracing, and give to the tower a true truss form from foundation to top story. It was, of course, impossible to run continuous diagonal truss members clear across the building from wall to wall, because such an arrangement would have interfered with the windows. It was determined, therefore, to consider the structure as being built up of four square corner towers and a central tower consisting of the elevator well, with wind bracing running through each wall of each tower continuously, from base to summit, the five towers being tied together in lateral planes at the various floors. The corner towers are 12 feet square in plan, center to center of the columns. This provides an open space 36 feet in width, down the center of each face of the building, which is entirely free from diagonal bracing. These spaces are occupied by large bays filled in with glass, as shown in our perspective drawing. The lighting of the corner towers is by single windows, which are so disposed as to permit the diagonal wind bracing to be carried continuously throughout the whole height of the tower, without interfering with the lights.

Of course, this method of bracing resulted in very high stresses in the chords of the trusses, which in this case are the vertical columns of the tower, and these columns are of exceedingly heavy construction. The wind pressure was assumed at 30 pounds per square foot, uniformly distributed over the whole face of the building, and the total overturning moment of the wind reaches the enormous amount of 128,000 foot-tons. The total weight of the tower alone is about 23,000 tons; and yet so great is the wind pressure that on the windward side of the building, should a storm ever blow upon it with sufficient velocity to produce an average pressure of 30 pounds per square foot, the building would tend to lift, the total uplift on a single column amounting to 470 tons. In order to provide against this, the columns are anchored to the caissons, the margin of safety against lifting amounting to never less than 50 tons on the column. The figures for the loading on a single one of the columns will be of interest: The total dead load at the foot of the column in question will be 289.2 tons, this amount representing the weight of the steelwork and masonry. To this must be added 60 per cent of the maximum live load, under which is included furniture, fittings, and the maximum crowd of occupants. This reaches, at the foot of the column in question, a total of 131.6 tons, making a total dead and live load of 420.8 tons. The downward pressure on the leeward side of the building, due to the wind pressure, is 758.8 tons, which, added to 420.8 tons, gives a total load on the column of 1,179.6 tons. The greatest combined load on a single column is 1,585 tons.

The effect of this stupendous structure upon the already remarkable sky line of New York city will be to dwarf the immensity of surrounding buildings and deceive the eye as to their already lofty altitude. This will be particularly true of the stranger who visits New York for the first time, for he will find it difficult to realize that the towering skyscrapers which are dominated so completely by this tower are many of them between three and four hundred feet in height. The question of the future vertical increase in the dimensions of buildings will depend upon the financial success of the Singer Building. Should it prove possible to realize an adequate return upon an investment of this kind, it is not unlikely that corporations with whom the advertisement that is given by a spectacular structure of this kind counts for something will, in future years, attempt to rival or surpass it.

It is the confident expectation of the engineers that in spite of the great height there will be no perceptible sway in the Singer Building even in the heaviest storm.

SEARCHING FOR THE REAL ORIGIN OF SPECIES.

(Continued from page 171.)

along the midrib and the margins become revolute. The leaves are widely different in width, those of the mutant being much narrower. The parental type is of a marked biennial habit and near the close of the season the internodes formed are extremely short, which has the result of forming a dense rosette; the mutant forms no rosette, by reason of the fact that the stem does not cease, or diminish its rate of elongation, and hence presents an elongated leafy stem which continues to enlarge as if perennial."

The common evening primrose has also been treated by Dr. Macdougal with a solution of zinc sulphate and one individual produced which differed materially from the parent. Of course, this might be a mutant produced by natural causes and not induced by the chemical treatment, though the probabilities are against such a condition. In nature, ovaries of plants might be affected, Dr. Macdougal believes, either by the action of gaseous emanations, by radio-action, by the introduction of foreign pollen, or by the stings and incisions of insects.

Dr. Macdougal has also tried the effect of raising plants at various altitudes above sea level, and while markedly variant types have been produced, he has so far been unable to fix the new types; for when the plants were returned to their original habitat, they reverted to the normal type. At present Dr. Macdougal is breeding plants at New York, Jamaica, and the desert laboratory in Arizona, at sea level, and at altitudes of 2,300, 5,000, 6,000, and 8,000 feet. The experiment will cover a number of years, possibly a decade, to see if in that time any of the new characters induced by the change of environment will remain fixed or not.

The search for the real origin of the species is now on in earnest. Apparently we are at present on the right track, but even if the search is not ultimately successful it is sure to give us a much clearer insight into some of the most mysterious secrets of nature.

Illiteracy in the City and Country.

In the matter of illiteracy among children the cities make a much better showing than the rural districts. The line between city and country cannot, however, be very accurately drawn, because cities with less than 25,000 inhabitants are not, for the purposes of this study, separable from the distinctively rural areas. Accordingly the area which, for convenience, is designated as country includes many of these smaller cities. In the country as thus defined the illiteracy among children is 88.7; in the city, using this term to designate collectively cities of over 25,000 inhabitants, it is only 10.4. The contrast is least in the North Atlantic States, where the so-called country includes many large towns or cities under 25,000 in which the school systems are by no means inferior to those in the large cities. In this section of the United States child illiteracy in the city is 7.8 and in the country 10.8. In the South the difference is very marked; in the South Atlantic division, 32.4 and 193.4 for city and country, respectively, and in the South Central, 44.9 and 181.3.

The greater illiteracy in the country does not necessarily indicate that the regard for education is less there than in the city. One cause of the difference is the difficulty of providing school facilities for a scattered country population. The development of the school transportation system, already inaugurated in many country communities, will tend to remove this disadvantage. Another circumstance also operating to the disadvantage of the country population is their smaller per capita wealth, which necessitates a smaller per capita local appropriation for school purposes. Realizing that a certain amount of public instruction is indispensable for the general good of the State legislatures in many States have imposed a State school tax. This system, by which the wealthier school districts are made to assist the poorer, will naturally tend to lessen the difference between city and country in the matter of illiteracy.