NEW WATER-WORKS.

Engineer Schuyler's Report on the proposed System.

FEW CHANGES ADVOCATED.

An Interesting Bit of Reading Regarding the Undertaking that Means so Much to Astoria.

Following is the complete report of the consulting engineer, Mr. James D. Schuyler, on the plans and specifications for Astoria's proposed waterworks:

To the Water Commission of the City of Astoria, Oregon:—

Gentlemen: With a due sense of appreciation of the distinction with which you have honored me by calling upon me for advice in the many important questions involved in the planning and construction of new water works that shall nicely fit all requirements of water supply, future demand, and available means, I shall endeavor to give you the result of of my studies of your project system as clearly as possible, and present my views in a manner that will, I trust, prove of possible value to you.

The expediency of building new water works for the supply of Astoria is apparent on the most superficial inspection. The present six inch pipe line is inadequate to the supply of the town. It starts at an elevation of 281.0 feet above sea-level, and terminates in a reservoir 160 feet above the city base It is twelve miles long, and has an average hydraulic grade of about 10 feet per mile. It never did carry over 200,000 to 225,000 gallons per day—less than 25 gallons per capita where you need 100 to 150—and it has only been increased in capacity to about 320,000 gallons per day by cutting the pipe near sea level and pumping up to the reservoir. A large part of the town has no water at all except from wells, and the supply is too short to afford irrigation to lawns or gardens in the summer. Evidently the city has outgrown its first primitive waterworks, and has reached the point where further growth must be accompanied by a corresponding expansion of its water supply.

The topography of the city and its general physical conditions as well as the growing wants of the community, demand an extension of water privilege to the higher levels and over greater areas, while a general revision of the arteries of distribution and the establishment of a sufficient number of fire hydrants in all parts of the city to afford adequate fire protection, is imperatively necessary. The city is so entirely built of wood that it requires a very perfect system for the extinguishment of fires and the reduction of insurance rates. That a devastating conflagration has not already occurred during the dry summer months is due entirely to good fortune; the fire department, although said to be an efficient one, would be seriously crippled and practically helpless in case of an extensive fire, as there are no fire hydrants in the city, and sole reliance is placed on pumping the supply directly from the river. It might easily occur that fire on the water front, if it got a start, would drive the firemen back and render the river unapproachable.

The new water supply, as designed by your engineer, Mr. A. L. Adams, is admirably arranged in regard to fire protection, and when completed it will inaugurate a new era in the history of the town.

Water Supply—

Astoria is abundantly provided with sources of water supply, thanks to the copious rainfall and the dense forests of this region. Young's river, and numerous other large streams to the south of the city, would afford practically unlimited supplies, but there is no stream so favorably situated for this purpose as Bear Creek (a tributary of the Columbia entering the river some 10 miles above Astoria) because of the high continuous ridge extending from upper Bear Creek to Astoria, the lowest portion of which is over 200 feet above sea level, affording most favorable supporting ground for pipe conduit on a nearly direct alignment. By any other route than along the ridge a pipe line entering Astoria must at some point be down to sea level elevation, and sustain very high pressure if the high parts of the city are to be supplied. Along this same ridge route can be conveyed the waters of Big Creeg and the North Fork of the Klaskanine—to supplement the supply for the city at any time in the future that it may have outgrown the Bear Creek supply, so that in round numbers it may be said that there is in sight by this route a supply of about 30,000,000 gallons a day, or a sufficient supply for 200,000 inhabitants. The watershed of Bear Creek above the proposed point of diversion, (including the little tributary of Cedar Creek, which is to be diverted into Bear Creek above the dam), is 4.82 square miles, according to the county map. Big Creek, by the same authority, has 23.35 square miles above the point of probable diversion and the Klaskanine, 10.10 square miles. The total area of watershed of these three streams is about 11.27 square miles, of which that of Bear Creek is but 11 1-2 per cent. It is gratifying to contemplate the fact that the supply which you propose to bring in, though comparatively large, is so small compared to the greater volume that can be gathered in the immediate vicinity by way of the ridge route. Bear Creek is evidently a stream with but slight variation in volume of discharge. There are no signs of drift wood, floating or lodged, no evidence of erosion, no appearance of very high water. This is due to the dense forest that covers and shades its water shed, and the great blanket of thick moss, leaves, and underbrush that receive and hold the waters of precipitation like a sponge, giving them off slowly and gently, to the stream througout the year. This condition is one conducive of clear water at all times, and is an ideal condition of uniform distribution of run-off that should always be maintained by careful preservation of the forest. Gaugings of the stream taken during the low water stage of August and September, for the past five years, indicate that the minimum flow during the dryest years is a little in excess of 3,100,000 gallons per day, below the mouth of Cedar Creek, a small tributary that is to be diverted into the head works of the new pipe line. The gaugings made are as follows:

LOW STAGE FLOW IN BEAR CREEK

MONTH.	YEAR.	OBSERVER.	Flow in Gallons per 24 hrs.	REMARKS.
August	1890	C. L PARKER	5,118,0.0	At old diverting point below the mouth of Cedar Creek.
"	1891	W. W. PARKER	4,781,000	" " "
"	1892	C. H ISOM, (eng.)	4,389,000	" " "
"	1893	"	5,646,000	At proposed head works in gorge.
August 21	1891	A. CARLSON	2,625,000	" " "
Sept. 2	"	"	3,215,000	" " "
" 5	"	"	3,510,000	" " "
" 9	"	"	2,722,000	" " "
" 13	"	"	2,522,000	" " "
" 23	"	"	2,508,000	" " "
" 26	"	LARS BERGSVIK	2,500,000	" " "

LOW STAGE FLOW IN CEDAR CREEK.

August 1	1893	C. H. ISOM, (eng.)	718,000	

Low water is confined to about six weeks of summer and autumn, and during nine months or more the average flow of the stream is probably about double the minimum. Calculating the discharge for the year on the basis of this assumption the total run-off of the entire water shed would amount to 30 per cent of the probable precipitation, assuming the rainfall to be the same as recorded in Astoria, where the mean precipitation, as shown by the records kept since 1850, has been 75.49 inches; the minimum being 49.38 inches in 1884, and the maximum being 100.42 inches in 1871.

A run-off of 50 per cent of this mean rainfall, or even more, may reasonably be expected from such a water shed, which would give an average daily flow of about 9,000,000 gallons. From all these facts and calculations of measurements of flow, which I assume to have been taken with a fair degree of accuracy, I draw the conclusion that if the conduit, as designed be constructed with a capacity of 4,000,000 gallons daily, it will not be too large to be fully supplied by the stream, provided the water shed be not stripped of its forests; nor will it be too greatly in excess of present consumption to be considered as an extravagant provision for future growth. In fact, I regard the capacity of the conduit as planned to be such as will best meet all conditions, of supply and demand. If the stream falls to a minimum of 3,000,000 gallons it is only for so short a period that the shortage of 1,000,000 gallons per day for say 40 days, can be made up by a small storage reservoir that may be constructed at the point of diversion which is located in a narrow rocky gorge, admirably suited to the cheap construction of a masonry dam, some 40 feet in height. Such a dam would be but 100 feet long on top, 20 feet at bottom, and would store approximately 46,000,000 gallons. Such a dam can be built for about 15,000. It need not be constructed immediately, but is an available resource for the future.

It is to be regretted that a survey has not been projected to Big Creek, and more definite data obtained regarding the route, the distance and the available supply from that source. It would only be the exercise of ordinary business prudence if the commission should take steps now, or as early as practicable, to acquire water rights on Big Creek, and secure that supply to the future city.

The Conduit—

The conduit as planned may be described as follows: Starting from a capacious settling basin immediately below the low masonry diverting dam, an 18-inch wooden-stave pipe extends for the first 11,800 feet, where the pressure is very light throughout; then follows 1,200 feet of 16-inch steel pipe crossing West Bear Creek, where the maximum head is 275 feet; then 10,400 feet of wood, with a maximum head of 150 feet; then 2,400 feet of steel; 3,600 feet of wood; 12,600 feet of steel; and finally, 12,750 feet of wood, reaching the summit of the ridge overlooking the city, at an elevation of 426.9 feet. Thence to the reservoir site the distance of 5,450 feet, and the fall 144 feet. A 14-inch steel pipe is to be used in this section. The total distance from the head works is 60,300 feet, or 11.42 miles, of which 38,650 feet, of 7.5 miles, is mooden stave pipe.

The proposition of using wooden-stave pipe over so large a portion of the conduit is one which has provoked considerable discussion and criticism in this city, because wood is generally regarded as so quickly perishable as to be of doubtful value to permanent construction. Under conditions of constant saturation, however, wood, which is ordinarily so perishable, becomes as durable and lasting as metal. Instances of the preservative effect of water on wood are in evidence all along the water front of your city, where piles below low water are sound as the day they were drived, 50 or 75 years ago. I have supervised the construction of more than 40 miles of this class of water pipe, 30 to 44 inches in diameter, used in the water supply of the city of Denver, Colorado, and through long familiarity with it have come to regard it with entire confidence, when properly constructed of the right sort of materials. The first pipe of this class that was laid has now been in use in Denver more than ten years, and when I examined it two years ago, was sound as the day it was laid, and probably is so still. In fact, all the water used in that city of 150,000 people, is conveyed in pipes made of wooden staves, held together by round bands of steel. They do not decay if kept in use, nor do they leak, or if leaks occur they are never serious enough to do any harm if neglected for weeks, and are generally stopped with a splinter, a thin wedge or sometimes a toothpic. We used a good deal of California red wood and some Colorado mountain pine, but Texas long leafed yellow pine was the material chiefly used. After carefully weighing the merits of each, I came to the conclusion before leaving there, that the Texas pine was quite equal, and in many resepcts preferable, to the red wood. This pine has but little pitch, and closely resembles the Oregon red fir, which certainly has remarkable enduring qualities, and in my judgment is entirely reliable for pipe purposes. I saw on the road to Bear creek, three large prostrate logs of red fir, apparently sound, that had been lying so long that trees one to two feet in diameter had grown on top and over them. These samples speak volumes in favor of the enduring qualities of the wood. Fortunately this material is the cheapest you could possibly use, on account of its abundance at your doors. The wood used for the staves needs to be clear, free from sap, or knots, or checks, and partially seasoned. If put together with round, mild steel bands, with maleable iron shoes, all carefully dipped or painted in some good paint, carefully jointed, every stick scrutinized to see that it has no defects, and all clinched up hard and tight, and thereafter kept full of water, the pipe thus made will last as long as iron pipe, at least, if not longer.

I have computed the relative capacities of the pipes—wood and iron—of different diameters, and find they have been correctly estimated by your engineer. I have also checked the calculations of strains on the pipes and find them of proper thickness to safely withstand all pressure that may come upon them. I would advise, however, that the 14-inch pipe be made of No. 12 steel, and that some of the 16-inch pipe, on pressures over 225 feet, be made of No. 10 steel. I have examined and checked the computation of the table of band spacing used and find they have a large factor of safety—somewhat larger than is customarily employed by engineers. The distribution of air valves and stand pipes for air vents, is sufficient to give ample air escape while the pipe is being filled, as well as admitting it in sufficient quantity to prevent general collapse in case of a sudden break. The blow-offs or flushes, are sufficiently frequent to enable one to empty the pipe in every depression—while the design of the manholes and covers of brick and wood, is sufficient to protect the valves they enclose, and give access to them. In short, no detail seems to have been overlooked in providing for a perfect conduit, and I find nothing about it to suggest in the way of improvement, except the addition of a small receiving tank or cistern at the head of the 14-inch steel pipe, 5,450 feet east from the reservoir, where the wood pipe terminates—the object being to break the conduit at that point, in order to prevent sudden shocks upon it by the closing of valves at the reservoir, and also to furnish a supply head for the third level service. The elevation at this point is 426.9 feet. A pipe should run from this tank west along the ridge to supply the cemetery and residences above the reservoir level, with a connection between this pipe and the second level service, controllable by a gate that may be opened by a device placed at the fire station, similar to the one designed by Mr. Adams for use at the low service reservoir. This enables the fire department to turn on an extra pressure, in case of fire, at very short notice by drawing on the supply

(Continued on Next Page.)