Reasons that have been advanced for the general delay in acquiring more detailed knowledge and data on ground-water flows centre largely around the historic fact that the combined sewer preceded the separate sewerage system. In the construction of the former, tight joints were not an important item, otherwise, ground and surface water would have had difficulty in finding its way into the system, such a condition rendering it less efficient. Entering upon the design and construction of separate systems, engineers and contractors somewhat included the importance of perfect jointing and the resulting leakage feature has become prominent. An instance is on record at New Orleans of the leakage of ground water into sewers attaining an extent of 1,250,000 gallons per square mile. This infiltration, perhaps not objectionable in storm sewers or drains, is unquestionably so in other sewers and the importance of careful design and workmanship to reduce leakage to the least possible amount is perhaps no greater in any other branch of municipal engineering.

Obviously, the amount of filtration is a function of the head of ground water on the sewer, of the linear measure of joints in the case of pipe sewers, and of the superficial area of the interior of brick or concrete sewers. The volume is usually stated as so much per acre, per square mile, per mile of sewer, per capita or percentage of dry weather flow, but there is little information by which an estimate may be made based on the fundamental considerations mentioned above. There should, at least, be some regulations to apply to work done by contract. This would naturally involve a determination of how much water the sewer might be allowed to carry without This determination materially injuring its usefulness. would depend upon the number and circumference of the joints.

At a meeting of the American Association for the Advancement of Science, Mr. J. N. Ambler incorporated in a paper which he read on this subject a part of his own specifications covering sewer construction. While effecting some very careful work and acting as a powerful deterrent to poor construction, the specification was not regarded by the contractors as unduly severe. Mr. Ambler states in his paper that he once laid a mile of large sewer through exceedingly swampy land passing several streams with the result that not more than a stream $\frac{1}{4}$ inch deep was flowing from the lower end of the sewer upon completion.

The following is an outstanding part of his specification:---

It is the intent of these specifications that no more leakage of ground water into the sewer be allowed than is admissible with a first-class piece of work, in which care has been exercised to get as near as possible to a watertight result.

To determine the admissible amount of leakage, the length of a joint will be considered as the outside circumference of the spigot end of a pipe.

Leakage not in excess of two gallons per day of twenty-four hours for each foot of circumference of every joint will be considered admissible, the amount of flow to be determined by the engineer's gauging in each section, by means of a notch board.

The contractor agrees that for each 10,000 gallons per day of twenty-four hours by which the total flow of the sewer exceeds what the total flow should be, when figured on the basis already given, a deduction of \$100 from the contract price will be made. This will not apply further than to a total flow resulting from three gallons per day of twenty-four hours, from each foot of joint length, beyond which figure the sewer will be regarded as not in compliance with this contract.

PROTECTION OF UNDERGROUND SURVEY POINTS.

In mining work it has been found that protection against rot of survey points is most important. The work of the mine surveyor largely hinges upon their proper location and upon their not having been disturbed, but in order that the survey stations may possess a longer life of service some method must be adopted to prevent decay or molestation.

If survey plugs are driven flush with the rock they are less subject to rot than when allowed to project. The use of horse-shoe nails has given place in many instances to brass spads. When survey points have to be set in timber, especially in new timber near a face, it has been found well worth while to carry the point down from the spad in the cap to a point on the sill or on a hub in the bottom. The cap and consequently the spad is more subject to movement than the point in the bottom. Furthermore, with the point set in the floor, any movement can be readily detected.

ULTRA-VIOLET RAYS STERILIZATION OF WATER IN AMERICA.*

A FEW weeks ago the contract was awarded by the City of Niagara Falls, N.Y., to the R.U.V. Co., Inc., of New York, for the installation of 35 "Pistol" lamps for the sterilization of water by the ultra-violet rays of the mercury vapor quartz lamp.

the ultra-violet rays of the mercury vapor quartz lamp. This is the first municipal installation of the system in America. The capacity of the filter plant in which they are to be used is 16,000,000 gallons per day.

The lamps will operate in banks of seven, and will be spaced 30 inches apart. Each bank will rest in a concrete channel 2 ft. wide, 3 ft. deep and 26 ft. long. Water will pass through the channel at a rate that will allow an exposure of 30 seconds to the ultra-violet rays.

The cost of the installation will be \$19,800, which will be augmented by the necessity of rectifying the electric current from alternating to direct. This equipment will cost approximately \$2,200. The guaranteed cost per million gallons for maintenance comprises current at 7 cents, and lamp renewals, based on a 2,900-hour life, 60 cents.

The Niagara Falls plant has been using about one grain of coagulant per gallon and five pounds of bleach per million gallons, thus costing about \$1.50 per million gallons for chemicals. With the introduction of the new process it is expected that the plant will be made more economical as well as more efficient.

[* An article on water sterilization by ultra-violet rays appeared in *The Canadian Engineer* for June 25th, 1914.—Editor.]

The Dominion Creosoting Company. Limited, of Vancouver, B.C., has received an order for 160,000 creosoted railway sleepers from the Bengal and Northwestern Railway Company of India. The specifications call for best quality, well seasoned Douglas fir to be treated with 12 pounds of creosote per cubic foot under specified temperature and pressure conditions.