THE USE OF INFILTRATION GALLERIES IN WATER SUPPLY.

THE water supply system of Brooklyn, N.Y., includes two infiltration galleries with a combined length of about six miles, in addition to some 25 driven well stations, collecting from 975 wells varying in depth from 30 to 325 ft. The system was described in a paper read before the New England Waterworks Association last September, and some interesting discussion was subsequently presented concerning the operation of infiltration galleries, in view of the successful use of them in Brooklyn. We refer to the following remarks by Alexander Potter, a New York consulting engineer, which appeared in the Journal of the Association for December:

The procuring of water supplies by means of infiltration galleries is not commonly resorted to. Even where the use of infiltration galleries promises to yield good results, engineers often hesitate to make use of them because of the many failures recorded, the causes for which either are not understood or when understood have not been brought to the attention of the engineering profession.

The proper design of an infiltration gallery should not be at all difficult, for the process which takes place in an infiltration gallery is duplicated in nature by the diffused seepage of the underground waters into surface streams. This ground-water seepage maintains the flow in surface streams long after the direct effects of the rainfall have ceased. The fundamental laws governing the ground-water flow of surface streams are fairly well understood and apply with slight modifications to infiltration galleries. They may be stated as follows:

1. The ground-water stream flow is fixed and limited to the surplus underground waters accumulating and stored in the valley.

2. The rate of seepage varies with the transverse hydraulic slope of the ground-water table and the porosity of the material through which the ground water flows.

3. When the hydraulic slope is not steep enough to discharge the surplus ground waters as fast as they collect in the valley, the ground-water table rises until equilibrium is established, and vice versâ if opposite conditions exist.

4. Except as affected by the seasonal changes of the rising and lowering of the ground-water level, the ground-water stream flow is constant.

There is no reason why the seepage of ground-water into an infiltration gallery under proper conditions should not be equally as dependable as the identical natural process of ground-water seepage into surface streams.

An infiltration gallery may derive its supply of water from two distinct sources: A supply derived by intercepting the surface underground waters which were under natural conditions joining the surface waters by diffused seepage, and a supply derived by infiltration from bodies of surface waters adjacent to the infiltration gallery. It appears that many infiltration galleries derive by far the larger portion of their supply from the second source. A carefully made scientific investigation will, in nearly every case, reveal within quite narrow limits the quantity of water available for an infiltration gallery from the two sources above mentioned, and as long as the draft does not exceed the available supply there is no reason why the yield of a properly designed infiltration gallery should gradually decrease with time, as is only too often the case. The recorded failures of infiltration galleries can, in the writer's opinion, be largely attributed to the erroneous assumption that a pipe laid below water level with open joints or perforations and surrounded by a porous material will continue to deliver the volume of flow developed when first constructed, ignoring entirely the fundamental law of supply and demand.

This is not true with infiltration galleries constructed on the floor of an impervious strata intercepting the transverse ground-water flow in a pervious strata of coarse sand immediately above. Under such conditions, infiltration galleries have been very successful. A typical example of such a gallery is the one constructed at Munich.

Under conditions other than that just stated, and where the supply appears to be adequate, there is often noted a gradual breaking down of the infiltration gallery, apparently due to the silting up of the filter media immediately surrounding the gallery. Under the natural conditions of ground-water seepage into surface streams, no such silting appears to take place, and when such silting up occurs in connection with an infiltration gallery, it can only be due to the peculiar ground-water conditions set up by construction of the gallery. The writer believes that the silting phenomena are primarily due to the high velocities of the ground water through the filter media immediately adjacent to the gallery, velocities so great that the finer particles of soil are transported to the gallery, gradually clogging the interstices in the filtering media and the gallery proper. This phenomenon of clogging is aggravated by the lowering of the ground-water level in the vicinity of the filter gallery below the top of the gallery. For a definite yield, as the wetted perimeter of the gallery decreases, the entrance velocity increases in inverse proportion. To attempt, therefore, to force an infiltration gallery to the extent of lowering the ground-water table below the top of the gallery, will tend to increase the danger from clogging and materially shorten the life of the infiltration gallery, especially when constructed in the finer sands.

With tubular wells, the question of high entrance velocity in the filtering media surrounding the well screen is not of equal importance; wells are comparatively short-lived, and when clogging does occur it can be remedied by back-flushing or other known methods. No such remedies are available for clogged infiltration galleries. When properly designed so that the yield of the gallery does not exceed the supply available from the surplus underground waters and the supply derived by infiltration from a nearby body of surface water, and the entrance velocities are sufficiently low so as not to transport the finest soil particle, the useful life of the infiltration gallery should be practically unlimited.

The yield from an infiltration gallery constructed in the finer sands should be automatically controlled so that it cannot exceed a certain predetermined amount, in order to prevent the lowering of the ground-water plane below the top of the gallery, so as to keep the entrance velocities within safe limits. This condition can best be secured by restricting the flow from the gallery to an amount which will keep the gallery constantly full of water for its entire length.

In many cases the requirements as outlined herein will for a given yield call for the construction of much longer lines of infiltration galleries, constructed in finer sands than has been the practice in the past, so that in many instances other methods of supply will be found to be more economical. Throughout the country, however, deposits of gravel and sand exist in the valleys of rivers and along lakes and seacoasts, in which infiltration galleries can be economically constructed to yield adequate supplies either from the surplus underground waters or from the water derived by infiltration from adjacent natural and artificial bodies of water, or from both sources. The

(Continued on page 272.)