

SANITARY ENGINEERING.—TOWN AND VILLAGE.

[It is proposed to give week by week the syllabus of Professor Bovey's lectures, with the questions to his students and their answers. The subject is one of great importance, and demands our best attention.—EDITOR.]

LECTURE I.

The object of the sanitary engineer is to obtain pure air and pure water, and the success of this object will depend chiefly upon the character of the works executed.

Sewage works have to perform three distinct operations:—(1) The drainage of the surface. (2) The drainage of the subsoil. (3) The removal of the fecal and other liquid refuse.

The preliminary inquiry in a district will embrace:—(1) The area of the district to be sewered. (2) The rainfall of the district, and the proportion to be admitted into the sewers. (3) The geological character and physical outline of the district. (4) The present and prospective numbers of the inhabitants. (5) The trades and occupations, generally, of the people. (6) The water supply of the district. (7) The road material. (8) The sanitary appliances already in operation, or to be adopted. (9) The ultimate destination of the sewage.

I.—AREA OF DISTRICT TO BE SEWERED.

A careful survey with levels must be made of the district, and should enclose as much of the surrounding country as contributes "surface" and "subsoil water."

("Surface water" is the water thrown off the surface tributary to the river, streams, or water courses.)

("Subsoil water" depends upon the nature of the subsoil, and the depth of the underlying strata.)

If an abundance of rain fall upon the high lands above the district, it is best to conduct it away by the natural courses, or to provide artificial means for its carriage, so as not to overburden the sewers by a large and intermittent supply.

II.—RAINFALL AND SEWERS.

The sewage works of a district must be designed to convey away, by sewers, storm-water overflows, or by special works, the maximum quantity of rain which falls in a minimum time, without flooding and inconvenience to the inhabitants.

The amount of surface water contributed by the rainfall will depend much upon the character of the receiving surface, but in no case is it advisable to exclude the whole of the surface water from the sewers.

The intention of such exclusion is:—(1) To increase the manurial value of the sewage. (2) To obviate the inconvenience attending the purification of a large and uncertain volume of sewage in times of rainfall. (3) To convey the rainfall to the rivers and the sewage to the lands.

The dilution of sewage by the rainfall is found, however, not to diminish materially its total collective value, though the expense of the application to agricultural purposes may be considerably increased. Also, it may be advisable to exclude the surface waters in some districts, but in others these are most impure, and would greatly vitiate the streams and rivers.

These impure surface waters occur:—(1) In urban districts, closely peopled, or liable to much traffic. (2) In districts with small rainfall. (3) Wherever they wash the streets, courts, roofs, &c.

In all such cases a large proportion of the rainfall must be admitted into the sewers and treated with the sewage.

The rainfall in rural districts is comparatively pure, and may be admitted to the ordinary watercourses.

In seaside towns, or wherever the sewers may become locked, the rainfall should be conveyed away so as not to overburden the sewers.

The "rainfall" is to be excluded from the sewers, when the sewage is to be chemically treated.

When pumping has to be resorted to, it is desirable to "intercept" the rainfall.

When the rainfall is admitted into the sewers, a percentage only of the actual rain finds its way there.

The mode of disposing of the sewage must have a predominating influence in ruling the admission or exclusion of surface waters.

Questions.

1. Give reasons showing the necessity of sewage works.
2. Diphtheria and typhoid fever have shown themselves in a group of houses; what are the most likely sources of it, and how would you proceed to examine for them?
3. What are the advantages and disadvantages of admitting rainfall to sewers?
4. Give your opinion as to the manurial value of sewage. H. T. B.

Replies.

1. The great reason seems to be the preservation of health among the inhabitants of densely populated places, such as cities, towns, and also in villages; and the size of the place would seem to be an important consideration, as the absence of sewers would not be felt so much in the country as in a village, or in a village so much as in a city. For the preservation of health, it is necessary to remove such water as may descend in rainfall, and with it all impure matters which it may have collected, such as dust and refuse deposited on the roofs of houses by the smoke from manufactories, houses, &c., also garbage, animal, vegetable, and earthy matters which gather in the streets, and sullage and liquid refuse of all kinds, which, if allowed to remain and become stagnant and decomposed in streets, would produce noxious gases and vapours, which are well known to be the germs of different diseases, and as these diseases are generally contagious, it would have a great effect on the mortality of the place. It would be likely also, by its soakage into the soil, to impregnate the water used for domestic purposes, and such we find to be very often the case. By comparing the present rate of mortality in towns which have a

good system of sewage with that of former years, before the system was brought to its present state of perfection, we find that they have experienced a very great decrease in the death rate, which would therefore seem to be one of the reasons shewing the necessity of sewage works. T. DRUMMOND.

2. Impure water for household use, cesspools, heaps of garbage and refuse and the noxious gases and vapours arising from them, and also from the drains in a defective system of drainage. The first thing to be done would be to examine the water, and if discovered to be impure to find out the cause, if there are noxious smells to find out where they proceed from, to examine the subsoil to find out whether it may be impregnated with impure matter, and whether the drains are satisfactory and in working order, and also if the ventilation is good. T. DRUMMOND.

3. The advantages of admitting rain-fall into the sewers are, that the rain-water helps to keep them from being choked up with filth, and washes all the refuse from the roads and streets. The rain also dissolves a portion of the noxious gases that are generated in the sewers, which would otherwise rise into the atmosphere. One of the disadvantages of admitting the rain is, that while it tends to carry away and empty the sewers of refuse matter, it introduces sand and gravel, which being in themselves much heavier than water will not move unless there is a very considerable incline, or slope in the sewer; thus the sand and gravel gradually choke up the sewer, and thus tend to increase rather than obviate one of the difficulties for which the rain was admitted. Another disadvantage is that if the sewage is to be treated chemically the admission of rain-fall would very much increase the expense. The capacity of the sewers will also be increased, thus increasing again the cost. R. W. WADDEL.

4. Sewage for a manure is one of the cheapest and best, for though the cost of laying pipes and making arrangements for the distribution of the sewage may be large, it will ultimately pay; for lands which have been treated properly with sewage are valued in some places at £8 to £12 stg. per acre, while lands adjoining, which have not been so treated, are only valued at 30s to 40s.

In dry weather the sewage is used to greatest advantage, for it not only manures the land but waters it.

In some places the land manured with sewage has become so rich that the proprietors find it necessary to pass the sewage through long, deep ponds, so that the sediment may settle before the water is carried over the grounds.

These lands bring a rent from £24 to £30, and some even as high as £57, per acre; so that the cost of laying pipes, &c., to convey the sewage to the lands would soon be counterbalanced by the high rents that the lands would bring or the value of the rich crops that they would yield. F. F. BUSTEED.

LECTURE II.

3. Geological character and Physical outline of a district.

The character of the geological strata has a most important influence upon the health of a district, and also materially affects the amount of surface water to be collected.

The physical outline of a district governs, to a great extent, the surface discharge, and the ventilation of sewers.

If a sewer is not water-tight:—1. The subsoil water enters and dilutes the sewage. (2.) The level of the subsoil water is lowered. (3.) Under an appreciable pressure, the sewage escapes into the soil.

Therefore:—1. Sewers should be water-tight. (2.) Subsoil water should be removed by a separate drain. (3.) Systematic drainage should accompany systematic sewage.

The contractor's temporary drains for removing surplus water during the progress of sewerage works may be easily made permanent and at a very little extra cost.

The common sewer and subsoil drain may generally occupy the same trench, but at times it may be injudicious to lay a subsoil drain directly below the sewer, and it may again be more economical to lower the subsoil water by drains altogether independent of the sewer.

4. Population.

Care must be taken to ascertain the present and prospective population of a district, so as to determine who do and will contribute sewage, and for whom water has to be supplied.

It must be considered, also, how far circumstances may alter the conditions of a town or village, and how far provision must be made for the admission of sewage from probable suburban parts.

5. Trades and occupations of the people.

The capacity of sewers is to a great extent governed by the amount of the liquid refuse from special and local trades to be admitted.

The water used by various trades is liable to become much polluted. This pollution, in some cases, will not prevent the utilization of the sewage upon land, nor its chemical conversion into dry manure, but in others the sewage will prove positively destructive to vegetation both in the liquid or dry state.

6. Water supply.

The sewerage works of a district are affected by the water supply by reason of the volume of water to be conveyed away.

The sources of supply to be considered are:—(1.) The volume of water distributed by specially constructed water works. (2.) The volume taken from tanks or wells. (3.) The volume contributed by manufactories.

Generally speaking the volume of water supplied for public purposes may be assumed to average 25 gallons per head for towns, and 15 gallons per head for villages.

The quantity of water used in a district will depend upon:—(1) The facilities afforded to the public for procuring a supply. (2) The sanitary appliances in operation within the district. (3) The character of the population supplied with water.

A higher rate of consumption of water will occur in districts where the water closet is universally used than where the supply is from isolated stand pipes, and in which the ashpit or some other dry process is in operation.

7. Road material.

The disposition of the material washed from the road and streets is a question of the utmost importance, and especially where such material is easily