SCIENTIFIC—SANITARY ENGINEERING.

Lectures by Professor H. T. Bovey, of McGill College.

ANSWERS TO QUESTIONS IN LECTURE No. VII.

2. On what grounds do some authorities propose the total exclusion of the rain-fall from sewers?

Ans.—In preventing the rainfall from entering the sewers, we have three objects in view:—(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 give to the streams of the country the natural volume of water due to the rainfall within their collecting areas. In some districts it may be important to keep the rainfall as far as possible out of the sewers; but there are others in which positive injury may be done to the fresh-water streams by reason of the polluted matter carried with the rain-water. In rural districts the surface drainage is comparatively pure, and consequently could be conveyed to ordinary water-courses without detriment.

J. T. Morkill (Partial).

4. What are man-holes and lamp-holes? State their uses, and define the points at which they are to be placed.

Ans.—A man-hole is a shaft leading from the surface of the ground down into the sewer, and of such a size that a man can descend it for purposes of inspection. A lamp-hole is a smaller shaft than a man-hole, and is used to suspend a lamp at the level of the sewer. If a sewer becomes filled up at a certain point, a man descends one of the man-holes. A lamp is let down the next lamp-hole beyond the obstacle to be removed. After the man gets down, a rod is handed to him, piecemeal; this he fastens together, and works it along the sewer till he strikes the deposit that is to be removed; when he thinks he has removed it, he looks along the sewer, and if he can see the light of the lamp, the sewer is open. One of the objections to these holes is, that they allow sewer gas to escape into the atmosphere. A lamp-hole or a man-hole should be placed where two sewers unite at all angular points, and at suitable distances apart; which distance should not exceed 300 feet.

R. W. Waddell (2nd year).

5. Draw up a specification for the brick-work of a sewer.

Ans.—The bricks to be machine-pressed, sound, hard, well-shapen, manufactured by one of the latest improved brick-machines, and equal to sample seen at office. No broken bricks of any description to be allowed in the works, and all bricks before being used to be approved by the Engineer. The bricks to be thoroughly soaked with water before being used. The whole of the brick-work to be executed in hydraulic mortar, flushed in and finished solid. "The work generally to be in rings in such bond as may be directed by the Engineer, and to break bond correctly with the bricks in adjacent courses. The courses to be laid evenly and uniformly to the curvature of the moulds and centres in neat, close, and regular joints not to exceed ¼ in. in thickness on the face; to be kept straight or regularly curved as required. The joints to be struck, cut neatly and flush with the face of the work. The arches to be cleaned off and carefully stopped as the centres are moved forward."

J. T. Morkill (Partial).

LECTURE VIII.

Construction of Sewers—(Continued.)

Stoneware and Earthenware Sewers.

Pipes of this type are to be made of a vitreous imperishable material, well burned, sufficiently strong to resist fracture, and tough enough to resist shocks; tenacious, hard, homogeneous, impervious in character, uniform in thickness, true in section, perfectly straight, uniformly glazed (salt) both inside and out, free from fire or other cracks, and which when struck will ring clearly.

This class of pipe is in general use for small sewers and house drains, the stoneware thickness for thickness being the superior.

The thickness of a stoneware pipe should never be less than one-twelfth of the internal diameter, and this proportion should be increased in the case of the smaller sizes of sewers. (*Ex.—A 4" pipe should be at least ½" thick, while a good 18" pipe need not exceed 1½" in thickness*). The dimensions of these pipes are given by tables, but the thicknesses therein specified often prove insufficient, and special care must be taken to observe this point.

The pipes are usually provided with sockets, which should be made with, and form a component part of, the pipe. The depth of the socket increases with the diameter of the pipe. The socket should be not less than 1½" deep in the smaller sizes of pipes, and when the diameter exceeds 12", the depth should be rather more than 2".

The spigot end should be laid down hill.

The pipes must be laid with a perfectly true line of fall from point to point, and must have a uniform bearing throughout the entire length, which necessitates the cutting of a recess to receive the socket. Great care must be taken to bed the pipes properly, as this will preserve the concentricity of the joints, as otherwise the pipes are liable to fail as girders.

To remove an ordinary pipe from a line of sewe[illegible]ree pipes at least must be raised, and in the case of large sewers a greater number. The foundation under the pipes must afterwards be carefully restored.

Joints should in all cases be caulked with tarred gaskin and laid and finished with cement, asphalte, or in some cases clay.

Asphalte should be used for joints under houses, and cement wherever the ground is surcharged with water or is at all unstable.

Each pipe should be jointed as laid, and before a fresh pipe is laid care should be taken to ascertain that no cement has got into the inside at the previous joint.

There are various modifications in the details of the construction of pipe sewers, most of which are liable to leak when running more than half-full, nor are such modifications required when lamp-holes and man-holes are used.

Concrete Sewers.

They should be constructed of gravel, or other suitable material which is cheap, good, and easily procurable.

If the whole of the sewer is to be of concrete, the bottom part is constructed first, and the concrete is rammed in behind a mould of the exact section of the sewer. The moulds are usually covered with greased sheet zinc. The upper portion is turned upon centres covered with metal.

The sewers are often pargeted with a coat of cement on the inside.

A considerable length of trench should be kept open, and the centres preserved in their place, until the work has completely settled. Special arrangements should also be made to prevent the collapse of the sewer before the work is solidified.

Concrete bricks may be used, but the work becomes very expensive.

Combined brick and concrete sewers are the best and most economical. They are not so expensive as entire concrete sewers, and are far cheaper and stronger than an entire brick sewer.

Cement Pipes.

Cement pipes form good sewers, and have been found perfectly sound at the end of twenty years; they are expensive. Cement pipes of large size, with socket joints, are used in Germany, withstand a severe climate, the chemical action of sewage, and also cost much less than a pipe or brick sewer of the same calibre. They are durable and remain in perfect order after a severe frost. The cement may be worked and moulded into any form, and will retain that form when so made. The pipes are very strong and capable of repair, improve materially by age, and in a little time will ring with a clear metallic sound. The cement, of course, must be very carefully chosen.

Rock Concrete Tubes.

Rock concrete tubes have an interior surface virtually lined with pure cement, compressed in manufacture so that it cannot peel off. They are rapidly made, are jointed with cement, ensuring an absolutely true and water-tight barrel.

Iron Pipes.

Castings are to be truly cylindrical, and the spigot to fit the socket exactly. All special pipes, as bends and junctions, are to be truly shaped and to join properly with the straights. The sectional area of every pipe is to be truly concentric, and any pipe which deviates more than ¼ from the specified thickness at any point is to be rejected. The following formula is useful in determining the thickness of a pipe:—

$$T = \text{thickness} = 10 \cdot H \cdot D \cdot \frac{62.449}{2 \times 144 \times 1500}$$

where H is the head of water in feet, and D the internal diameter of the pipe in inches.

The pipes are to be tested by hydraulic pressure up to twice the working pressure.

Questions.

1. A long sewer of circular section has a uniform slope; show that if the water is to attain the greatest velocity the stream must only partially fill the channel; and if A be the supplement of the angle subtended at the centre of the section by the unwetted portion of the circumference, then $\pi + A = \tan A$.

2. A low-level sewer of circular section recently constructed in Torquay is seven feet in diameter, and is capable of discharging 8,000 cubic feet per minute; will it be a sewer of deposit?

Find the fall, and also the "head," which would be sufficient to maintain the velocity of discharge, the length of the sewer being about 2,000 feet.

If the sewer were constructed of brickwork, what should be its thickness?

H. Taylor Bovey.

21st November, 1878.

Consumption of Timber.—In pleading for the protection and perpetuation of forests, the *Lumberman's Gazette* gives some interesting particulars of the amount of timber consumed every year in the United States. "We have now," it says, "about 90,000 miles of railroad; the annual consumption for ties or sleepers alone is 40,000,000, or thirty years' growth of 75,000 acres. To fence these roads would require at least 130,000 miles of fence, which would cost $15,000,000 to build, and take at least $15,000,000 annually to keep in repair. We have 75,000 miles of wire, which requires in its putting up 800,000 trees, while the annual repairs must take 300,000 more. The little, insignificant lucifer match consumes annually in its manufacture 300,000 cubic feet of the finest pine. The bricks that are annually baked require 2,000,000 cords of wood, which would sweep the timber clean from 50,000 acres. Shoe-pegs are quite as important an article as matches or bricks, and to make the required annual supply consumes 100,000 cords of fine timber, while the manufacture of last and boot-trees takes 500,000 cords of maple, beech and birch, and about the same amount is required for plane stocks and the handles of tools. The packing boxes made in the United States in 1874 amounted to $12,000,000, while the timber manufactured into agricultural implements, waggons, &c., is more than $100,000,000. The farm and rural fences of the country consume an immense amount of lumber and timber annually, but as we grow older as a nation, this consumption may, and probably will, be reduced by the more general use of live fences or hedges. Our consumption of timber is not only daily on the increase, but our exportation of timber is also rapidly increasing. Our staves go by the million to France annually; walnut, oak, maple and pine to England, and spars and docking timber to China and Japan."