this surfacing was found in excellent condition. It would appear that if any sealing coat is used in connection with this construction that it it should be rolled in together with the balance of the road instead of attempt being made to roll it on afterwards.

At the end of the season of 1911 the vitrified shale cubes laid in 1909 on Road No. 6 were still in good condition and showed but little effect from wear. The Portland cement concrete cubes made with soft gravel and laid the same year showed the effect of wear but still preserved a good smooth surface, except for a short stretch of 100 ft., where they had broken up. The reason for this break seemed to be a weakness of a foundation. The concrete cubes made in moulds very wet, which were laid in 1910, were found to be soft in the spring of 1911, and did not hold up under traffic. The frost seemed to have disintegrated them. Of the ash clay cubes laid in 1909 the soft burned ones did not stand up well, but the ones made with small amount of Jersey clay mixed with local clay and ashes were in good condition.

This piece of road was subjected to very hard usage by the frequent passage of heavy agricultural engines with very sharp lugs on the wheels. It seems to be demonstrated that with cubes made tough enough to stand the wear of traffic, this form of pavement will be cheap and satisfactory.

## THE EFFECT OF SAFE WATER SUPPLIES ON THE TYPHOID FEVER RATE.*

Disasters have occurred from drinking sewage polluted water due to three distinct reasons:

One.—Failure to purify a surface supply exposed to pollution.

Two.—Inefficiency of the purification.

Three.—Failure to supply the purified water to all parts of the city.

**Failure to Purify.**—The failure to purify a supply which is polluted or exposed to sewage pollution may usually be attributed to an undue confidence in a supply which is safe "most of the time." It is difficult to impress upon municipal officials, without a severe lesson, that to avoid disaster it is necessary to have a water supply safe 365 days in the year. It is difficult to make them see the necessity for purification when the supply may be safe 350 or 360 days in the year.

They consider the expense almost unjustifiable when the menace only exists for four or five days in the year. But when disaster occurs they are willing then to spend the money after the damage is done. Erie, Pa., extended their intake pipe far out into the lake. It was nearly five miles from the nearest source of pollution. During 1909 and 1910 there was no evidence of serious pollution, but in December, 1910, such pollution occurred, and was followed in the early months of 1911 by 135 deaths and over 1,300 cases of typhoid fever.

There is too much confidence placed in unfiltered surface supplies from inhabited watersheds. Even where there is alleged control of the watershed and ample storage, pollution may occur. In regard to unfiltered surface supplies the need of bacteriologic control is very evident. Dangerous pollution may be present only for a few days or for a few hours. This is most likely to be disastrous in time of drought or low water. At such times the diluting effect of the inflow and the purifying effect of storage are both reduced to the minimum. The bacterial count per cubic centimeter is valuable, but the quantitative estimation of B. coli is of far greater importance. A low count does not necessarily imply a safe water, but a low count coupled with absence of B. coli may be considered an index of safety.

The typhoid epidemic in Baltimore in 1910 was coincident with prolonged drought. The run-off from the watershed of the Gunpowder River was reduced to the minimum. The sewage pollution was thus concentrated, and gross pollution was evident upon bacteriological examination. B. coli was frequently found in 0.1 of a cubic centimeter, and sometimes in 0.01 cubic centimeter samples. When the run-off increased, affording greater dilution and increased storage, the water returned to normal and the typhoid fever dropped to a minimum.

In Europe, surface supplies are almost invariably filtered, and eventually such supplies in America will be treated or filtered.

The factors affecting sewage pollution of a water supply and which determine the relative danger to be anticipated for such pollution are:

The amount of polluting material, the presence of pathogenic organisms, the time of transit from the source of pollution to the waterworks intake, and the amount of water available for dilution.

Provided the amount of polluting material is considerable, that typhoid fever is prevalent on the watershed, and at the time of transit is within the bounds of time deemed necessary for the natural death of bacteria, pollution of the intake will take place. The last factor, the amount of dilution, will determine the intensity of the pollution. If the polluting material is great in amount, and if a swift current cuts down the time of transit, prevents sedimentation and retards dilution, then gross pollution results.

With a dilute pollution one need not expect a great explosive outbreak, but many cases of typhoid may result, especially following floods and rains. Often in the absence of explosive outbreaks in the winter or spring months it will be demonstratable that too many deaths from typhoid fever occur in the first half of the year. On the other hand, it is reasonable to suppose that the dilute infection may be responsible for many scattered cases which can not be traced to water.

These cases may not appear in sufficient numbers in any particular month to be remarkable or they may be obscured by occurring in the months when typhoid fever is accepted as an inevitable visitation.

Water may be responsible for many cases of typhoid when it is impossible to prove the case against it. We are able to fix the guilt on the water supply only in massive outbreaks of explosive character, but smaller doses can be responsible for smaller outbreaks or many cases spaced over a long period without any hope of proving this causation.

It seems quite probable that a dilute pollution of a water supply with typhoid organisms may exert an influence indirectly through the agency of milk. The very few organisms in the water through multiplication in the milk may be enormously increased.

**Inefficiency of the Purification.**—There seems to be an impression that the installation of the filter plant means safe water. This is not necessarily true.

The filter plant must be properly constructed and intelligently and efficiently operated. I have seen filter plants that were structurally perfect, intricate mechanisms designed after plans by our best engineers, yet these plans are sometimes placed in the hands of an assassin, entirely innocent of knowledge of the proper bacteriologic control of his plant.

Poor filter efficiency is often responsible for disaster in the shape of typhoid outbreaks, and may be due to several

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