CITY WELLS.

AT a conference of state and municipal boards of health held at Washington last December, ten propositions were unanimously agreed to. The first of these is, 'that all surface-wells should be closed at the earliest possible moment.' This has special reference to the surface-wells in cities. Why do these wells deserve such sweeping condemnation? We have only to consider the conditions surrounding them, to have a reason suggested. In cities in which there are no sewers, it is well known that the discharges from the inhabitants are conveyed to cesspools, where they are allowed to remain indefinitely. Sometimes the contents of these cesspools are imperfectly removed; sometimes they are not disturbed, a new cesspool being dug in the neighborhood of one which has become filled. They are rarely built carefully, but are usually merely holes in the ground, lined with sufficient stonework to prevent the earth from falling in. In some cities they are dug in exactly the same way as the wells which are intended to supply drinking-water. The digging is in each case continued until water is reached. Communication is thus established with subterranean currents, and the refuse matter which finds its way into the cesspools is at least partly carried away. This saves some trouble; but what becomes of the refuse matter? Under very exceptional circumstances, it may find its way to some large body of water which is not used for drinking-purposes, and thus do no harm. If, however, there are wells in the neighborhood, the chances are in favor of the contents of the cesspools and of the wells becoming mixed. The larger the number of cesspools and of wells, the greater the danger of such a result. In a city not provided with sewers, therefore, the conditions are such as to lead almost certainly to contamination of the water of surface-wells with the contents of the cesspools. Besides this, there is the danger of contamination from surface-drainage, which cannot be avoided. The water which falls upon the ground, whether the ground be paved or not, sinks to a considerable extent below the surface, carrying with it such impurities as may be present. Such surface-water in cities, it is safe to say, is always contaminated. Some of it is sure to find its way into the wells.

This latter source of contamination is common to all cities, whether they are provided with sewers or not. While, however, the city which is provided with sewers is not subjected to exactly the same kind of danger as that first referred to above, the cases do not present as much difference as might at first be supposed. The sewers are generally leaky, and the soil in their vicinity becomes saturated with sewage. Thus they may contribute to the contamination of the well-waters. Of course, the danger of such contamination is not so great as when there are no sewers, but still it is quite sufficient to justify the condemnation of the surface-wells.

The waters of city wells have frequently been studied by chemists and biologists, and the results invariably show that contamination is the rule. In Brooklyn, N.Y., there were, in 1882, three hundred and sixteen wells. Chemical examination showed, "that, of this whole number, but seventeen furnished water fit for human consumption." Similar results have been reached in an examination of the water of the wells of Baltimore, where a few years ago there were between one and two hundred in use. The contamination of some of the waters examined was such as to show that very close connection must exist between the wells and cesspools. The testimony of all who have given special attention to the subject of the water of city wells is unanswerable. Not only does a consideration of the surrounding circumstances lead us to suspect that the water must be contaminated, but the most careful examinations, by those most capable of making the examinations, have shown that actually, and almost invariably, the water is badly contaminated.

It is an unfortunate fact, that, though the waters of city wells are generally impure, their external properties do not always reveal the impurity. Sometimes they do; and then it requires but a very slight hint as to the cause of the properties, to stop the further use of the water. Thus, for example, some years ago there was a spring in Baltimore, which, owing to its peculiar taste and odor, was regarded as a mineral spring. It was therefore fenced in, and covered, and generally treated like others of the class known as 'mineral springs.' It was afterwards found that very close connection existed between it and a neighboring cesspool; and the cause of the taste and odor which had given the water its reputation was thus revealed. It need not be added that the water ceased to be popular. More frequently these well-waters are clear, and without taste and odor, and, coming from greater depths than the service-water, they are generally cooler. Frequently, too, they are used for years, and many who use them continue in good health. There are, of course, in every community, many who are able to resist bad influences. They furnish

no evidence for or against the danger of using bad water. The influences are felt principally by the weaker members of a community.

As regards the specific objections which may be raised to using the water of city wells, it may be said, in the first place, that the evidence is pretty clear that water contaminated with sewage does at times give rise to low fevers. Though it is difficult to furnish satisfactory proof of the statement that the use of contaminated water tends to lower the general condition of health of those who habitually use it, those who have paid most attention to the subject unanimously agree that pure water is as important as pure air for the preservation of good health. One of the chief dangers in the use of water contaminated with sewage is, that, by establishing connection between the sick and the well, it contributes to the spread of some forms of epidemic disease. As is well known, it is now held by many of the highest authorities that in some diseases the organisms which are believed to be the active causes are given off from the patients with the alvine discharges. If, now, by any means, these organisms or their germs are introduced into the system of a well person, the diseased condition is set up. What more efficient method of distributing these organisms than drinking water which is contaminated with the contents of cesspools! Exactly what forms of disease may be spread in this way, it is difficult to say; but there is strong evidence in favor of the view that typhoid-fever and cholera are among them. Over and over again, outbreaks of typhoid-fever have been traced with practically absolute certainty to the use of water known to be contaminated by sewage. In regard to cholera, the evidence is quite sufficient to justify the destruction of all city wells.

IRA REMSEN.

THE SHIP-RAILWAY BETWEEN THE ATLANTIC AND PACIFIC.

THE article by Mr. Hubbard, in *Science* of Nov. 4, 1884, on canal routes between the Atlantic and Pacific, discussed briefly the advantages of the three routes and methods proposed. The object of the present paper is to present the scientific and commercial reasons why the ship-railway across the Isthmus of Tehuantepec may be superior to either the Panama sea-level canal, or the Nicaragua lock canal.

It is estimated that $50,000,000 will be ample to put the ship-railway into operation for the transportation of vessels of 5,000 tons. The estimated cost of the Nicaragua canal on a cash basis is $140,000,000, and of that at Panama, as high as $350,000,000.

The route *via* Panama, between Liverpool and San Francisco, is about 700 miles longer than by Tehuantepec; between New York and San Francisco, about 1,200 miles; and between New Orleans and San Francisco, about 2,000 miles. Probably 1,000 miles excess of distance would be a fair average.

The time in transit across the isthmus would be at least three days shorter at Tehuantepec than at Nicaragua for either a steamer or sailing-vessel. The Suez canal, which is 100 miles in length, delays a steamer 48 hours in transit, or her passage is at the rate of about two miles per hour: two-thirds of the distance is through the lakes, and there are no locks. At Nicaragua, about one-sixth of the distance only is through an open lake; and there will be from twelve to twenty locks, at each of which a vessel will be detained nearly an hour. The time required for passage, therefore, will be about four days; so that, although the total distance is shorter than at Panama, the time required for a steamer would be about the same.

In the article by Mr. Hubbard above referred to, reference has already been made to the favorable situation of Tehuantepec with reference to the trade-winds.

It is also hoped that the maintenance will cost much less per annum than that of either canal. The Panama canal being below the level of the sea, with the slopes of its enormous cuts exposed to the wash of the tropical rains, the difficulty of removing the material washed into its prism, and the controlling of the Chagres River, make the maintaining of the ship-channel difficult and expensive. At Nicaragua the conditions are nearly similar.

The ship-railway will not be subject at any point to the ravages of floods. It will be built over its entire length, on the solid ground, with excellent materials at hand for construction and maintenance. On either side is a natural harbor, which with small expense, by the construction of jetties, will give two excellent ports. The climate is remarkably healthy, and native labor abundant and cheap. It is located in a country which has a comparatively strong government.

The estimated total cost of maintenance and operation in lifting, hauling, and placing the vessel with its cargo in the water again, is less than thirty cents per ton of cargo carried.

The great doubt which must exist in the mind of the reader is in the practicability of lifting and hauling a loaded vessel. The method