## THE SHEFFIELD WATER SUPPLY AND LEAD-POISONING.

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MOST of the readers of the SANITARY RECORD will be aware that Sheffield is abundantly supplied with water of moorland origin on the gravitation system. The water is very similar in general character to that supplied to Manchester, Huddersfield, Glasgow, and several other large towns, being of only two or three degrees of hardness, and, except for the occasional presence of peaty matter, is generally regarded as of excellent quality.

In the summer of 1885 a medical man in the town called the attention of Dr. Sinclair White, the medical officer of health, to certain cases of undoubted lead-poisoning, of which the origin was obscure. Dr. White consequently instituted a systematic inquiry on the subject, and submitted to me for analysis samples of the company's water, amounting in the aggregate to upwards of three hundred. The results of the investigation, and the conclusions therefrom were embodied in a report presented by Dr. White to the Health Committee on Jan. 21, 1886.

The investigation showed that, at the time experiments were made—*i.e.* the summer and autumn of 1885 —the water derived from the Agden and Strines reservoirs and distributed to the low-lying parts of the town by means of the Godfrey Dam, had practically no action on lead pipes, the water drawn from ordinary house-taps containing no appreciable quantity of lead, even in cases where it had stood in the pipes all night.

On the other hand, in every instance in which the water was drawn from taps in houses supplied with the Redmires water, distributed to the higher districts of the town by means of the Hadfield Reservoir, a very notable quantity of lead was present. When the water had stood in the lead pipes all night the proportion of lead in some cases exceeded half a grain per gallon. In water drawn from the same taps in the afternoon the proportion of lead was considerably less, but still such as deserved consideration. Although at the time the waters were submitted to me I was ignorant of their origin, in every instance the results of the analysis enabled the water to be distinctly classified, only the samples obtained from houses supplied with the high-level water then containing serious quantities of lead.

containing serious quantities of lead. Meanwhile, Dr. White had heard of and investigated some scores of cases of undoubted leadpoisoning, which were not traceable to the occupations of the persons affected. On the other hand, every one of these cases occurred in houses supplied with high-level water, and analysis always showed the tap water to be contaminated with lead to a serious extent.

During the past month or two there has been an alarming increase in the number of cases of leadpoisoning attributable to the water. Whereas there were a few scores of cases some years since, the cases now or very recently under treatment must number several hundreds; and the great majority, if not the whole, of these cases have occurred in the parts of the town supplied with the Redmires water. The proportion of lead in the water derived from

Redmires is now usually from one-half to one grain per gallon; but it sometimes reaches one and a quarter grain per gallon, and occasionally exceeds this proportion. (This is my experience. Other chemists speak of having found still larger amounts.) On the other hand, the samples of low-level water which have come under my notice have rarely contained more than traces of lead; though in cases where it has stood in the pipes all night, as large a proportion as one-tenth of a grain, or slightly more, has been found.

Why there should have been recently a marked tendency of part of the Sheffield water to act on lead, and why the tendency should be limited almost entirely to the water derived from a particular district, as is apparently the case at present, are two very interesting problems. Before attempting to offer a solution, it may be well to explain that the Corporation of Sheffield only acquired the waterworks on January 1, 1888, as the result of their opposition last session to a Bill promoted by the late water company asking for increased powers. The Bill, and the scientific witnesses called in support of it, recognised the tendency of the Sheffield water to act on lead, but without making any distinction between the high-level and low-level supplies. Consequently the company's Bill contained a clause under which they were to be compelled, if called upon by the Corporation, to adopt an elaborate system of filtration of the whole of the water at a cost of f100,000, which was to be borne by the consumers. The method was precisely defined in the Bill, and was to consist of filtration of the water through successive layers of sand, limestone, and flint.

The object of using this combination was to impregnate the water with silica, which the advisers of the water company said they had discovered to be an absolute preventative against lead-corrosion, when the proportion of silica was kept at fully half a grain per gallon of the water. They gave no explanation of their proposal to use limestone in addition to the flint, and, in explanation of the fact that limestone alone had been found of service in similar cases, Dr. Tidy stated that it was simply the silica in such limestone which gave it any efficacy. Assuming the presence of I per cent of silica in the limestone used, which is a liberal estimate, it is evident that so grains of limestone would have to be dissolved in one gallon of the water in order to obtain the half grain of silica requisite for protection, and the water would have its hardness increased by 50°! The proposal was subjected to severe criticism by the opposing scientific witnesses, who showed that at Keighley a severe attack of lead-poisoning had been arrested by adopting the comparatively cheap and simple method of placing blocks of limestone and a certain quantity of quicklime in the conduit from the reservoir. It was suggested by the advocates of the limestone treatment that its effect was due to its power of neutralising the free acid present in the water, and they showed that the water which acted on lead was distinctly acid. The exact nature of this acid was then, and to some extent is now, uncertain, but it is highly probable that it is of vegetable origin, and arises from the oxidation of the peat on the moors from which the water is derived. The hot and dry summer would probably assist the oxidation, and when the autumn rains came the acid products would be dissolved and pass into the reservoir. The comparatively small quantity of rain

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which has fallen during the past six months has prevented the dilution of the acid to the usual extent. As a consequence, the water running from the Redmires reservoirs at present contains free acid of some sort, equivalent to o'6 grain of sulphuric acid per gallon, and that this is the cause of its action on lead is rendered more probable from the fact that the same water contains o'6 grain per gallon of silica; an amount which, according to Dr. Tidy and his coadjutors, should be sufficient to secure perfect immunity from action on the lead-pipes. At the water are unusually low.

As to the marked difference in the tendency of the high- and low-level supplies to act on lead, the only apparent explanations are to be found in the fact that the latter supply is in part obtained from a reservoir (Dale Dyke), the water in which has been a long time in storage, instead of being derived largely from the rains of last autumn, and in the circumstance that the low-level supply passes through a brick culvert two miles long, the mortar of which may not improbably effect the neutralisation of the free acid.

All these points might have been advantageously inquired into officially and at leisure; but so far no systematic investigation seems to have been made, and anything I have done myself has been in a purely pivate capacity, and under grave disadvantages as to obtaining samples. Alarmed by the enormous increase in the number of cases of lead-poisoning, the Water Committee have now had blocks of bimestone placed in the gauge-basin at Redmires, and in the conduit leading from Redmires to the service reservoir at Crookes. This has been done under the direction of the engineer to the late water company, Mr. Eaton, now an official of the Corporation, who in a report dated January 25, refers to the 'so-called lead-poisoning."

Assuming that the presence of free acid in the water is really the cause of the present lead corrosion, the limestone treatment is undoubtedly a step in the right direction, but the experience at Keighley showed that such treatment was insufficient, and required to be supplemented by the use of quicklime. The rough-and-ready method of placing this in the conduit, as was done at Keighley, is objectionable in The use of too much will injure several respects. the character of the water and render it quite as liable to act on lead as if it were untreated; while the use of too little will not remedy the evil, as I understand they have discovered at Keighley during the past year. The only rational way of using lime is to introduce it regularly and constantly, in powder or as milk of lime, in such quantity as previous analysis shall have shown to be required for the neutrali-sation of the free acid. This could be done very simply and inexpensively, but so far the water committee have contented themselves with the limestone treatment. Meanwhile, the numerous cases of lead-poisoning have caused something like a panic

• At a meeting of the Sheffield Town Council on February 8, it transpired that in the opinion of some members of the Water Committee it was not certain that the lead-poisoning was really due to the water. This scepticism exists in face of the united evidence of the medical men that lead-poisoning is very prevalent in some parts of the town : of the chemists that there is lead in the tap-water in genatily competent to produce poisoning, and of the disappearance of the symptoms of lead-poisoning under proper medical treatment and discontinuance of the use of the contaminated water. No other explanation of the lead-poisoning is suggested by those who express doubt of the water being the cause. in the upper parts of the town, and a most alarming waste of water is occurring through people 'letting the tap run' for periods varying from minutes to hours. In one case the head of a large establishment has had the whole of the taps kept fully running throughout the night. This is in the face of the caution of a correspondent of the local newspapers, who pointed out that the running to waste of one or two gallons of water would do all that was possible by such means. The rainfall continues very low, and at present the draught upon the reservoirs is as great as in the height of summer, and exceeds the inflow.

As soon as the public are authoritatively assured that the action on the pipes is no longer to be feared, owing to the suitable treatment of the water, this dreadful waste is likely to be arrested, but until this is done it is to be feared that the panic will con-Meanwhile, the filter manufacturers and their tinue. agents are driving a roaring trade, it having been found that many of the best forms of carbon filter are capable of removing dissolved lead from water. In some cases, especially those of certain carbon blocks, this power appears to be limited in extent and time; but animal charcoal seems capable of acting for a very prolonged period, probably owing to the large proportion of phosphates contained in it and the consequent formation of the highly insoluble phosphate of lead. Experiments I now have in progress are yielding very interesting results in this direction, and will be published in due course.

Since the limestone was introduced into the conduit and gauge-basin and Redmires, I have several letters from consumers alleging that the water has now become hard 'like London water.' This idea is very curious, for experiment shows that the hardness has only been increased by about half a degree, the water being still very soft. The lime even now only amounts to  $\frac{3}{4}$  grain per gallon, and it is possible that the insignificant proportion of lime, and consequent great softness of the water, have as much to do with the action on lead as the presence of the acid.

The whole question is one of great importance to the public and interest to the chemist, and it is to be regretted that so favourable an opportunity as has recently occurred of solving the whole problem and adopting a rational mode of cure has not been utilised to the utmost.

THE BALLOT AT LOCAL BOARD ELECTIONS.—The Clerk of the Swinton and Pendlebury Local Board (Mr. W. Joy Hewetson) lately addressed a letter to the Local Government Board inquiring whether the proposed County Government Bill will provide for voting by ballot at Local Board elections. He has received the following reply:— 'That, as regards your inquiry, the Board do not consider that they could properly make any statement at the present time as to the provisions which will be contained in the Local Government Bill.'

FELS' GERMICIDE SOAP is a toilet preparation containing various antiseptic substances, including naphthols, eucalyptus, and the perchloride of mercury  $(\frac{1}{1000})$ , for domestic disinfection. It is difficult to say how much disinfectant power is to be attributed to the first two, but the sublimate in the proportion of  $\frac{1}{1000}$  is a powerful though inoffensive germicide. These ingredients are incorporated in a good soap basis, with an agreeable odour, and the tablets are well adapted for the lavabo of the medical man and the washstand of the nurse, as well as for the cleansing of articles of clothing, &c., from infected sources. 1

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