

## PURE WATER.

BY A FAMILY DOCTOR.



It would, I think, be difficult to overrate the value and importance of good water, either to the individual or to the community at large. It must be patent to every one that the imbibition of impure or adulterated water tends to induce disease in the system. We take but little note of the chronic diseases which may be thus induced, though it is just possible they may be, in the long run, more numerically fatal than the more terrible disorders, such as typhoid and cholera, which force themselves upon our notice.

It is the inhabitants of our large towns and cities who suffer the most, owing to the wholesale pollution of the streams on which they depend for their supply, and the imperfect purification of the element by the water companies. People also who live in small outlying country villages are often victims to the curse of impure water, owing to a bad system of drainage, and to cesspools—often unemptied for years—being allowed to exist in close proximity to the wells. People, on the other hand, who live quite in the country, and take their drinking water from running streams, which are purified by the air and by subsidence, or from springs that bubble up cool and clear from the bowels of the earth, have little to complain of, unless it be the frequent hardness of the water.

If space permitted I could give numerous instances of the dangers to life from the use, either directly or indirectly, of polluted water. I shall only mention two that occur to me at this moment. A year or two ago there was a sudden outbreak of typhoid in one portion of the town of Halifax. For some time the health officer was considerably puzzled how to account for it, until one day he happened to visit a dairy farm, where he found that the only water the cows had access to was positively black and putrid. No fewer than nineteen of the typhoid cases had been supplied with milk from this farm.

Last summer a friend of mine, with his wife and family, went to reside at a house in the country, which he had taken. There was a good supply of pump-water. The water was bright and clear, and had neither bad smell nor taste, and it was consequently freely used for some days, when every member of the family was seized with diarrhoea and great thirst, and in one instance with a burning sensation at the back of the throat. The sucking baby was ill too, and, rather strangely, the two dogs were just as bad as any one else. The well was found to be within four feet of no less than three cesspools, and as the house had been empty for some months before my friend had taken it, and the water not drawn off, the well had had plenty of time to get thoroughly poisoned.

The inhabitants of London suffer, perhaps, in a

greater degree than those of any other city or town in the kingdom, from the evil effects of impure water. It is somewhat startling, in fact, to be told by such an authority as Dr. Lyon Playfair, that not far short of 1,000,000 people pour their excrementitious matter into the Thames, *above* the intake of most of our water companies, that this number includes the inmates of many hospitals, that the horrible impurities are not chemically changed or destroyed during their course down-stream, and that no sort of filtration avails against the pollution of this water.

Till such a state of matters be in some way mended, and the inhabitants of other towns as well as Glasgow be supplied with water they can drink without danger, I think it behoves every one, at least every head of a family, to do something in a private way to render the water used in the household, at least, as good as can be. To show how this may be done, is the object of this paper.

The safest plan for the Londoner would undoubtedly be never to drink any unfiltered or unboiled water at all. This was old Peter McFarlane's plan:—When old Peter lay a-dying, and the doctor told him, in answer to his anxious query, that his complaint was water on the chest—

“Dinna joke wi’ a dyin’ man, doctor,” was Peter’s reply. “It may be *whuskey*, but it canna be water. I havena drank a drap o’ water for fifty years.”

Sandy McFash was another canny Scot. He lived on the banks of a very polluted stream, and used the water too. “But, man doctor,” he explained to me, “I never tak’ a drink without first taking the precaution to *put a cinder in’t*.” Sandy’s cinder, of course, meant a drop of something strong. But I cannot recommend Sandy’s plan.

Although it may be taken for granted that the water supplied to all towns is generally more or less polluted, still it may be as well here to explain shortly how water may be in the simplest manner examined for impurities.

For this purpose you must provide yourself with a round or globular glass flask, which will hold, say, a quart. Sometimes a common bed-room water-bottle, if clear and thin, may be used. It must be perfectly clean, being rinsed out with strong sulphuric acid (beware of accident however), and then washed out several times with the same kind of water you mean to examine.

Having filled your flask, you may first examine it for suspended impurities. If much of these are present, by holding your flask up against anything dark, while it is at the same time in a strong light, they may be distinctly seen floating in the water.

If it contains much suspended impurity, especially if the colour is bad, it is decidedly unfit for domestic use. To test the colour you must have a second flask filled with pure distilled water, and place them both

together in front of you on a sheet of white paper and in a good light, in order to compare them. Only take care that the glass of which your flasks are composed is a clear glass.

Water that smells badly, even though the smell be but slight, is not fit to drink. To examine for this have your flask only about one-third full, and shake it before you smell it. Or better still, warm the water slightly; if there be any bad odour about it you will readily detect it. Another plan is to add a small quantity of caustic potash to the water after warming it, then if the water contains organic matter you will scent it at once.

The presence of ammonia, if you can detect it, is proof that the water is unfit for use; and this is easily done by the use of the Nessler reagent. This you must procure from a chemist. A little of this added to a small flask of water will, if ammonia be present, produce a yellow or brown colour or precipitate.

The presence of nitrites in water ought to condemn it. To detect these you must make a mixture of iodide of potassium with starch paste and acetic acid. If a little of this added to the water produces a blue colour, the water is polluted beyond a doubt.

If you live in the neighbourhood of manufactories and suspect pollution from them, the water having either an acid or an alkaline reaction would be strongly suspicious. This is very easily found out, by boiling in a test-tube over a spirit lamp a little of the suspected water, first with a morsel of red litmus paper; if the paper should turn blue, you have an alkaline reaction; if not, repeat the experiment with a bit of the blue paper, which will become reddened if the water is acid.

Many waters contain minerals to a greater or less extent. Some of these minerals are undoubtedly poisonous, as lead for example. The presence, too, of over-much iron in water for constant use is decidedly objectionable. Nevertheless, the occasional use of some of these mineral waters is often beneficial and tonic. I think there can be little doubt that the salubrity of certain districts, and the benefit to a stranger from a short residence therein, often depend as much upon the minute doses of certain minerals in the water, as upon actual change of air or scene itself. How far the constant imbibition of such water may injure the health and shorten life, we are as yet unable to tell.

The methods commonly used to purify water are three—viz., Distillation, Precipitation, and Filtration.

1. *Distillation*.—This is a process of purification which, for obvious reasons, cannot without trouble be rendered practicable for domestic purposes. It is regularly employed at sea however, for the purpose of rendering salt water fresh and drinkable. Coals have the power of distilling nearly nine times their own weight of water. Carrying coals instead of water is, therefore, a very great improvement on the old plan of conveying water to sea in tanks. Distilled water contains no air, as pure spring water does; it has a peculiar flat and vapid taste in consequence, and often a disagreeable empyreumatic taste and smell.

It has been recommended by some authorities, that

when bad water is supplied to a household, it should be boiled before being used. This plan certainly has some advantages; but nevertheless, from the fact that the water is thus deprived of air, it is thus like distilled water rendered flat, unpalatable, and actually indigestible. Again, water either distilled or boiled, as soon as it cools commences to supply itself with the air around it; and if this is in any way impure, the water may be rendered a fruitful source of disease. For these reasons water which has been boiled for the purpose of purification, ought to be aerated as speedily as possible, by ventilation or agitation in a current of pure air, and afterwards kept in covered tanks or vessels. Dr. Normandy, a few years ago, invented a water distilling apparatus of great ingenuity, whereby the water was re-aerated by the air of which it had been deprived. This is a good plan, inasmuch as the air in water contains more oxygen than common air does. The water from Dr. Normandy's apparatus is thus pure and soft, and sweet as spring water, and I only wonder that, seeing how small and compact the apparatus is, it is not in more general use on shore.

2. *Precipitation*.—Waters that contain organic matter may be greatly purified by the addition of a little alum. This is a very old plan and a very good one. It may be put to a practical test in the following manner:—Dissolve about a teaspoonful of pure alum in a little hot water; this, if added to four gallons of your suspected water, and the water well stirred and allowed to settle, will throw down the larger portion of the organic impurities. The purified water may afterwards be filtered.

Hard water often contains much organic matter, and this can be removed to a great extent, and the water softened at the same time, by what is termed Clark's softening process. Hard waters are such as attack the soap and destroy it without forming a lather. They contain the carbonates of lime or magnesia, held in solution by an excess of carbonic acid. It is not quite so simple an operation as the alum one, but still, with a little care, any one may perform it. The only approach to a difficulty lies in the fact that the quantity of lime-water to be used depends entirely upon the amount of hardness in the water. You must possess yourself of a solution of nitrate of silver, and a test-tube; if you now half fill the tube with your hard water and add a few drops of the solution, you will find that it gives a yellow or white precipitate. Now what you have to do is to add lime-water to your hard water, until instead of a white or yellow you have a brown precipitate in a given sample. Then add no more lime-water, but instead fill up your water-butt with the ordinary hard water, until on testing it with the silver solution you no longer find the brown precipitate.

3. *Filtration*.—This is the process of purification most common in households.

If water or spirit containing suspended matter is passed through blotting paper or very fine gauze, the matter is retained in the filter. This is little more than simple straining, but there is much more in the philosophy of filtration than this. In a properly con-

structed filter, not only does the downward action of gravitation come into play, but there is a lateral attraction besides, of the filtering medium, and added to this a purification of the water *by* the medium, not depending on mechanical principles. Some filtering media have the power of destroying organic matter (removing even the dark colour of the brownest water), and substituting carbonic acid. In the mighty laboratories of nature, it is no doubt in this way that the carbonic acid found in such abundance in the sparkling waters of some springs may be accounted for.

The glass of Seltzer water, so refreshing on a warm summer's day, may have been but a week before the brown unwholesome soakings of a bog, changed in one moment to what you see it, by the magnetic action of the media over which it had to pass in its passage to the earth's surface.

Animal charcoal possesses in a very high degree the power of separating water from organic impurities. There is no doubt that it even oxidises them. There is hardly any filter so good as the charcoal and sand filters. Nowadays they can be bought so good and so cheap, and the various kinds are so well known, that there is little need for me here to give any description of their construction.

N.B.—As the charcoal will always foul to a certain extent, the best filters are those which can be occasionally exposed to the air, dry, in order to give the charcoal an opportunity of re-charging itself with the oxygen of the air, and thus freeing itself of the organic matter, which otherwise would render the apparatus less efficient.

The reader will doubtless have heard something about what is called the "germ theory." Indeed it is now considerably more than a simple theory. I shall here only mention it in so far as it bears reference to our present subject. It has been fully proved and demonstrated by Professor Tyndall, that clouds of disease-bearing germs are constantly floating here and there in the air, and that by this invisible and implacable foe humanity suffers more than by battle, accident, or famine. Now the system adopted by most water companies of not allowing a constant supply of water to towns, without the aid of cisterns, is an exceedingly bad one. But still, as long as such a system does exist, all we can and ought to do is to see that our cisterns are regularly cleaned out at stated intervals; and not only this, but that the water in them is never exposed to the air, and consequently to the pollution of passing germ-clouds.

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#### THE CHAINED EAGLE.

**I** SAW an eagle by a brazen chain  
Bound to a rock, and slowly through the bone  
The fether gnawed its way. At times in tone  
Of agony he screamed, and in his pain  
Beat his great wings and struggled, but in vain,  
To free himself, then sank upon the stone  
Exhausted for a season: but anon

He started up, to writhe and fall again.  
Thus hourly did he: never conquering,  
Nor ever conquered: nor could any man's  
Compassion aid him. Though his agony  
Woke pity in the sternest, none could bring  
Him any succour. Type he seemed to me  
Of some great soul chained down by circumstance.

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## A HARD CASE.

### CHAPTER THE FIRST.

"And it was but a dream, yet it yielded a dear delight,  
That had been in a weary world my one thing bright."

*Tennyson.*

BREAKFAST was over in the dingy parlour of Dr. Waldram's house in the High Street of Okehill. It was a bright summer morning, fresh and pleasant after a night of rain, but even the sunlight which streamed in at the window failed to make the room anything but ugly and unattractive. Heavy old furniture, once handsome, but now spoiled by neglect, a crumpled table-cloth, cracked and ill-matched china, and the remains of a poor uncomfortable meal, showed that in that household there was not only poverty, but want of taste and care.

The room was now empty, except of one person, a young woman, who still sat at the head of the table with a letter in her hands which she unconsciously

crushed and crumpled, while bitter, angry thoughts were reflected in her face.

Sarah Waldram had awakened that morning believing herself to be a happy woman, but the letter she held in her hands had brought hopes and happiness to a sudden end. Hitherto she had led a poor, dull life in her father's house, with few friends, few interests, and few pleasures; but for some time now she had scarcely cared, for all the love she could feel she had given to John Strange, an old acquaintance, who, to her great surprise, had come to her one day and asked her to cast in her lot with his, to leave her dull home for one which, though little less poor, would be brightened by his love and care, and to help him with her good sense and firm courage to rise to a better position than his own unaided efforts could ever get him. All this had happened a year or two ago; and for awhile John had gone on working steadily in the