Could we have dispensed with water?

Apart from under unusual circumstances, such as those caused by the floods in Gloucestershire in August (see p731), pharmacists today have little problem with water: they just turn the tap and there it is — water suitable for drinking and most dispensing purposes. Peter Homan, honorary secretary of the British Society for the History of Pharmacy, takes a look at a time when things were not so simple

Water is the substance of life. It can also terminate human life if the life it supports causes diseases such as cholera or typhus. Up to and including the middle of the 19th century sources of drinking water included distilled water, rainwater, well water, mineral springs, lakes, streams and rivers. It would have been unfortunate for the 18th or 19th century apothecary, chemist and druggist or pharmacist if the water he used was killing off his clientele. Physicians would sometimes write in their prescriptions the type of water that they required to be used. The two most common were aqua fontana (spring water) or aqua destillata (distilled water), but others included aqua communis (common or plain water), aqua puteana (well water) and aqua pura (filtered water). Moreover, some physicians prescribed pills or powders with instructions to the patient to take them with "small beer", a weak beer resulting from a second fermentation of the beer mash. This was slightly safer (and, perhaps, more palatable) than drinking water because the water used had been boiled before the brewing process.

The source

According to Pereira's 'Materia medica' (1854), "besides rainwater some spring, well, and river waters are remarkable for their purity. The water of the Malvern springs is remarkable for its extreme purity. According to Sir Charles Scudamore's analysis this water contains only about a third part of the solid matter found by Mr R. Phillips in Thames water taken at Chelsea."

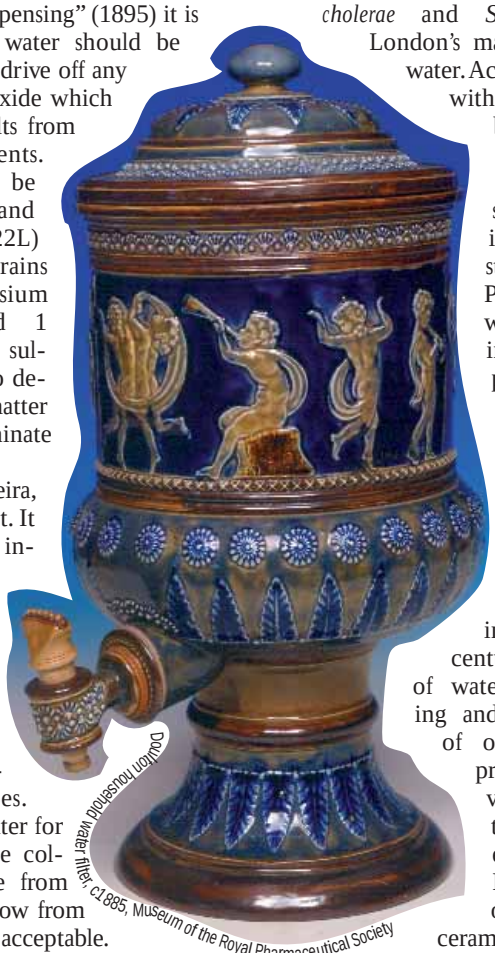
Pereira makes further comments about various waters. He noted that the purer the water the more it would be contaminated with lead from storage vessels and water pipes. Distilled water, however, had no action on lead provided air had been excluded. In addition, mineral water appeared to have a "protective action" against lead poisoning that varied according to its contents.

However, it was not until 1885 that the British Pharmacopoeia stated: "In dispensing prescriptions, aqua should be understood to mean distilled water." Aqua fontana was not to be used unless specifically ordered. For official preparations it said: "Natural water, the purest that can be obtained, cleared, if necessary by filtration; free from odour, unusual taste, and visible impurity. To be used whenever 'Water' is ordered in the British Pharmacopoeia." The monograph on distilled water describes its preparation as:

Take of Water 10 gallons
Distil from a copper still, connected with a block-tin worm; reject the first half-gallon, and preserve the next 8 gallons.

In "The art of dispensing" (1895) it is suggested that the water should be boiled before use to drive off any absorbed carbon dioxide which might precipitate salts from medicinal ingredients. The water should be freshly prepared and each 5 gallons (22L) should have 10 grains (600mg) of potassium permanganate and 1 drachm (3.5ml) of sulphuric acid added to destroy any organic matter that might contaminate it.

According to Pereira, rainwater was suspect. It was not too pure in industrial towns — having passed through heavily polluted atmosphere — and could easily be contaminated with lead via gutters, gulleys and drainpipes. Collection of rainwater for dispensing should be collected at a distance from the town. Melted snow from the countryside was acceptable.


Doulton household water filter, c1885, Museum of the Royal Pharmaceutical Society

Well water was similar to spring or mineral water. It was recommended that the well should be at least 20m deep, have an impervious lining and was not situated less than 100m from a cesspool. It also required a well-sealed cover on a raised brick wall and a pump — a bucket on a rope is a romantic image but was an easy source of contamination unless kept scrupulously clean.

For Pereira, water hardness was another consideration. He states that hard water is a "less perfect solvent of organic matter than soft water; hence, in the preparation of infusions and decoctions, and for many economical purposes, as for tea-making and brewing, it is inferior to soft water; and, for the same reason, it is improper as a drink in dyspeptic affections. Moreover, it proves injurious in urinary deposits. The unfavourable effects of hard waters are especially manifested in horses."

The problem with lakes, streams and rivers was that, although they might have appeared clear and pure, they were often used as open sewers for villages, towns and cities. Despite this, the River Thames, containing *Vibrio cholerae* and *Salmonella typhi*, was London's main source of drinking water. According to "Table traits, with something on them" by John Doran (1854), water from the Thames was "offensive to the sight, disgusting to the imagination and destructive to the health". Pereira states: "Thames water, when taken to sea in casks, soon becomes putrid and offensive, and evolves inflammable vapour." This was due to gases formed from organic material decomposing.

Filters

Perhaps the greatest innovation in the 19th century for the production of water suitable for drinking and for the manufacture of official pharmaceutical preparations was the development of water filters. It is believed that as early as 1827, Henry Doulton was working on the development of ceramic filters which would remove bacteria from drinking water. Traditionally, filters for water were composed of layers of substances such as sponge, gravel and charcoal. These filters could not be cleaned and had to be renewed. Doulton's filters were made from various earth and clay materials and could be scrubbed clean and reused. Queen Victoria was impressed and, in 1835, commissioned Doulton to produce a water filter for the Royal household. In 1862, Doulton introduced a manganous carbon filter and was able to manufacture filtering apparatus for commercial and domestic use, many of which were highly decorated.

The next development by Doulton was in the use of diatomaceous earth, also known as kieselguhr, to produce ceramic filters. This is a naturally occurring, soft, chalk-like sedimentary rock that is easily crumbled into a fine white or off-white powder and has a high silica content. It is composed of the shells of diatoms — pre-historic, algae-like creatures. Dampened and fired it produces a

filter capable of removing 99 per cent of water-borne bacteria. The filters were cast in the shape of candles with a hollow centre closed at one end and these were enclosed in a lidded vessel. Water permeates through the filter and is carried off through the empty centre of the candle. This principle is still in use today in industrial filtration.

In 1901 Doulton was knighted and in 1902 he was conferred the royal warrant and the right to use "royal" in front of his company's name for his work on drinking water filtration. However, Doulton was not the only manufacturer of filters. Operating in the second half of the 19th century was the Silicated Carbon Filter Company in Battersea, London.

The company manufactured filters which, in an advertisement in *Chemist and Druggist*, it describes as "the most effective means known of purifying water for domestic, manufacturing and general purposes". Its range included pocket-sized filters for travellers and it published an analysis of the effect of the silicated carbon filter upon Thames water obtained near Battersea Bridge at high water (see Panel).

In *Chemist and Druggist*, of 14 March, 1868, the company had announced :

The filtering media employed in the manufacture of these Patent Filters consist of an intimate combination of carbon, in its most effective form, with minutely divided silica, as these substances exist in the celebrated Torbane Hill mineral; and it has been satisfactorally demonstrated that this compound, prepared under the patent process, is immensley MORE EFFECTIVE in the purification of water than carbon, both as an oxidiser and as a promoter of chemical combination generally.

It also claimed the advantages of its filters included that:

- They removed all colour, taste, and odour arising from the decomposition of organic matter, and rendered the most noxious gases harmless
- They entirely removed the poisonous salts of lead and other bases even when in solution
- They imparted freshness to flat water
- They had purifying properties, which were "unerring and continue undiminished"
- The filtered water has no tendency to produce animal or vegetable organisms
- They materially reduced water hardness.

Advertisement for the Mawson filter in *Chemist & Druggist Diary*; 1895

- They were free from derangement, and general economy "as experience has satisfactorily proved that they do not become softened by continued use like moulded charcoal"
- No water could pass except through the silicated carbon because as it was securely held in the filtering vessels by "a pure, impervious, and insoluble cement", while with other filters where tubes or corks were used, much of the unfiltered water passed "by capillary means between the tubes or corks and the carbon"

And lastly:

Because, with the sole exception of salt water, there is none they do not render SPARKLING, WHOLESOME, and AGREEABLE.

J. H. Graham & Co of 25 Finsbury Place, London, produced carbon block filters for household and bedroom use which "received high commendation from medical authorities". The Berkefeld Company in Germany were producing ceramic filters in 1891. They had an office at 121 Oxford Street, London. In 1985, Doulton acquired the rights to the Berkefeld trademark, later changed to British Berkefeld.

The Mawson Filter Co, 137a Pilgrim Street, Newcastle-on-Tyne, produced gravitational filters adapted for "Dwelling-houses, Schools, Hospitals, Soda-water Factories, etc., giving a continuous supply of pure water without attention . . . Perfected with the aid of exact analysis, tested by experts and Medical Officers of Health, and adopted after rigid trial by the highest authorities in Sanitation in the world."

The main problem with filters is that they need cleaning. Deposits would build up and it was possible for bacteria to grow on this deposit or even through the filter. Cleaning with a brush was recommended every three days. This period was extended in the 20th century by impregnating the outside of the filter with silver which renders bacteria unable to reproduce. The ceramic candle-type of filter is still used today and they can be scrubbed up to 100 times.

By the 1930s Britain's tap water was regarded as safe to drink, although it was not always suitable for dispensing. In 1955, the BP Addendum introduced purified water, which was produced by distillation or treatment with ion-exchange resins. This was water of BP standard and from then on, had to be used where "distilled water" appeared in a formula.

Effect of the silicated carbon filter

	Unfiltered	Filtered
Total solid contents of an imperial gallon (about 4.5L)	33.5 grains (2.2g)	8.7 grains (0.6g)
Hardness, as determined by Clark's test	13 degrees	6 degrees
Earthy carbonates deposited by boiling one gallon	11 grains	None
Organic matter contained in an imperial gallon	3.8 grains(0.2g)	0.6 grains (39mg)

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