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From toilet to tap
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Thank Prince Albert for clean water and drains

FEW would imagine that Queen Victoria's consort, Prince Albert, is one of the fathers of public health and modern technology. And yet the industrial world—and Britain, in particular—owe this undemonstrative and devoted family man from Coburg a debt of gratitude far greater than the many monuments, bridges and concert halls erected in his honour.

Apart from insisting that all the profits from the Great Exhibition of 1851 be used to establish museums and colleges in nearby South Kensington, Albert played a vigorous part in creating—and staffing with leading German chemists—the forerunner of the technological powerhouse that became Imperial College.

He spearheaded other attempts to drag Britain's lamentable education system into the emerging technological era. Though his royal commission's recommendation for a *Gymnasium* form of public education was rejected by Parliament as being "too foreign" for English sensibilities, three technical high-schools modeled along the lines of the German *Technische Hochschule* were subsequently established.

Prince Albert

More by accident than good judgment, your correspondent attended one of them before going on to read engineering at the college bequeathed by the prince in South Kensington.

But perhaps even more we should be grateful to Albert for one thing he didn't do. He died, at 42 years of age, from typhoid fever in 1861. A grief-stricken

Victoria wore black for the rest of her long life. And of the many acts she undertook to enshrine her husband's memory, one of the most important was to insist that the other of his twin passions—public health—be given the highest of government priorities.

At the time, the Thames was effectively an open sewer, with disastrous consequences for public health. The cholera epidemic that swept through London in 1854 led to demands for clean water supplies and proper sewage systems in cities across the country. But Parliament turned a deaf ear until "The Great Stink" of 1858 sent sanitation concerns about a putrid Thames wafting through the adjacent House of Commons.

Ironically, the water-closet, invented in the late eighteenth century but popularised in Victorian times by an enterprising London plumber called Thomas Crapper (hence the word for defecation), contributed hugely to the river's pollution.

Before indoor plumbing, people disposed of human waste by emptying chamber pots into cesspits. That was bad enough. But flushed toilets increased the volume of foul water and human waste flowing into cesspits dramatically. These then overflowed into streets and rainwater drains that emptied into the river.

The summer of 1858 was relentlessly hot and dry. With natural rainwater runoff into the Thames and its tributaries at a minimum, the river had slowed to a trickle. As a result, most of the mass oozing downstream was excrement and foul water from flushed toilets, along with dead animals, factory waste, and other detritus. Bacteria thrived, and wealthy Londoners fled to the countryside to escape the stench and fear of disease.

Fearing as much for their own health, the politicians voted £3m (about $400m in today's money) for a massive network of sewers to channel the city's waste to downstream outfalls, where it could be released untreated into the Thames estuary when the current was flowing favourably.

The project involved six west-to-east interception sewers fed by 450 miles of main sewers and 13,000 miles of local sewers. It took the famed city engineer Joseph Bazalgette six years to complete. And every time parliamentarians sought to penny-pinch his project, an adamant Queen Victoria was far from amused.

Apart from becoming the model for every other major city in the world, the London sewer system spurred an awareness everywhere of the need to process sewage before discharging it. Nowhere was this more essential than in Britain, where large urban populations and small rivers made the pollution payload on the waterways excessive.

To their credit, the Victorians adopted not only primary sewage treatment (allowing the solids to settle out first), but also secondary treatment (injecting oxygen into the decomposing liquor) so bugs could digest the biodegradable contaminants and reduce the health hazard and smell significantly. They even carried out a rudimentary form of tertiary treatment (adding lime and sulphate of alumina) to reduce the chance of infection still further.

By the 1920s, full-scale tertiary treatment (filtering, disinfecting and lagooning) had become common practice. By adding further refinements, like irradiating with ultraviolet light, the treated water would later be injected back into the water table ready to be pumped out again for drinking.

One sewage plant in the Thames Valley your correspondent visited many years ago boasted it processed the same water at least six times before it eventually escaped to the sea. He drank the output and thought it rather better than chalky product that spluttered from London taps.

Earlier this week, the mayor of Los Angeles, Antonio Villaraigosa, did the same at one of his city's water-recycling centres. Los Angeles has been recycling sewage for irrigating parks and golf courses since 1929. But the thought of using it to recharge aquifers—let alone to pipe it direct to people's taps—is currently more than Angelenos can stomach.

Yet, an hour's drive to the south, water officials in Orange County recently opened a $480m recycling plant for recharging local aquifers and injecting the product into the littoral water table to prevent further incursion of seawater. Though the water that leaves the recycling plant is actually purer than tap water, local citizens are still far from ready to drink it directly.

But having been persuaded by a $4m promotion campaign, they are at least happy to see it used to replenish their aquifers. In short, they will cheerfully drink a dirtier version that's been messed up by nature after being injected back into the ground.

There are good reasons why water authorities are trying to coax us to drink recycled sewage. Global warming has affected snowfalls on mountains everywhere. As a result, water tables are falling, rivers are drying up and droughts are lasting longer than ever. Meanwhile, rising living standards, compounded by increasing populations, are increasing demand.

As a commodity, drinking water is increasingly in short supply. We need to conserve and recycle it.

To see the future, go to Singapore. NEWater is the brand name given to recycled water produced by Singapore's Public Utilities Board. To the standard purification process, the board has added not only ultraviolet radiation but also microfiltration and reverse-osmosis—two membrane technologies used in desalination plants.

The resulting water is so pure local authorities believe it's wasted on humans. For the time being, while acceptable water can still be imported from Malaysia, NEWater is being sold largely to the semiconductor industry, which needs a cleaning fluid thousands of times purer than tap water. The pragmatic Albert would have applauded the Singaporeans' prowess.