

THE CONTAMINATION OF FOOD AND WATER.

The contamination of food.

One of the major determinants of the level of food and water-borne diseases is the degree of care with which food was stored, preserved and eaten. Many micro-organisms, particularly those transmitted by flies, enter the system at the stage after food has been gathered. Furthermore, before modern canning and freezing, the preservation of food could be extremely dangerous as it deteriorated in store. Finally, many diseases could be transmitted during the cooking and eating processes.

Starting with England, we may note De Saussure's comment that 'nowhere can you see finer markets than in London...they are vast, covered, and shut in, and in them you can find every kind of butcher's meat, the finest in all the world, and kept with the greatest cleanliness.'¹ In the light of this, it may be necessary to question Riley's conclusion that 'practices in the slaughterhouses, uncleanliness in the preparation and handling of food, the open-air marketing of food, and similar risk-laden features of alimentation appear to have remained unchanged between 1670 and 1860.'² Again, it is worth noting the use of eating utensils. As long as food is eaten with the hands, as it is in the majority of societies, there are serious health risks. The history of the knife, fork, spoon and new, cleaner plates, takes on a new importance. For instance, the fact which Harrison noted in the sixteenth century of the movement from wooden plates to pewter, and of wooden spoons to silver or tin may have effects on the incidence of infection.³ The change occurred particularly rapidly after the 1730s, and is another important effect of tea drinking in particular. Likewise the rapid growth of tin, glass, spoons and ceramics from the early eighteenth century, originally to cope with the new hot drinks, may have been very important.⁴ Eden and others thought that the changes in tableware was enormous in the eighteenth century.⁵ Or again, the improvements in the nineteenth century which introduced the canning of meat and vegetables after the pioneering work of Brian Donkin in 1812, are of great importance.⁶

¹ De Saussure, *Foreign*, p.171

²Riley, *Insects (xerox)*, 844

³ Harrison, *Description*, p.201

⁴Shammas, *Consumer (xerox)*, pp. 173, 183-5.

⁵Shammas, *Consumer (xerox)*, p.188.

⁶Tannahill, *Food*, 310

When we turn to the case of Japan, the dangers of food contamination would seem to be even greater. The hotter climate in the summer and the very dense population using night-soil in agriculture were just two of the factors which would lead to the danger of extensive pollution of food.

One notable feature of Japanese food is the way it is prepared. With fish there are particular dangers of food poisoning. This seems to have been dealt with either by eating the fish absolutely fresh - often raw, and sometimes, much to the disgust of foreigners, in slices from the still breathing creature. If it could not be eaten raw, it was very carefully preserved using salt, drying, or a mixture of the two. Just one example of the preparing process for bonito will give an impression of how much care was taken. The bonito had their heads removed, were gutted and each cut into three pieces. They were cooked and boiled in special, soft, spring water. Cooled again, all the bones were removed with tweezers. The fish were then baked by putting them on a frame over a pinewood fire and slowly dried out. They were then put in a barrel for three weeks until mould began to grow. 'When the mould had turned white they were taken out of the barrel, dried again in the sun, then scraped with a rough hemp brush to knock off the mould.' After this the bonito were 'rough planed'. They were then dried again, put back in the barrel and further mould grew which was then scraped off again and a 'second planing' was done. This was repeated for a third time and finally the fish were given what was called the 'main planing' to prepare them for sale. In a particular town there were twenty-four men just to do this planing so, as the narrator recalls, 'you can understand how much work went into making each piece.'⁷

This meticulous attention was devoted to many foodstuffs, for instance the making of soybean chunks or **tofu**.⁸ Vegetables were first very thoroughly washed. Geoffrey described how 'Vegetables, scrubbed till they looked like Christmas-tree ornaments rather than prosaic carrots or purple eggplant or tapering white daikon, were ranged temptingly in baskets.'⁹ Or as Morse noted, 'One immediately observes in the market how thoroughly cleansed are all forms of ground vegetables, turnips, radishes, onions etc.'¹⁰ Then they were cooked, not eaten raw. King noted that 'Few vegetables are eaten raw and nearly all foods are taken hot or recently cooked if not in some way pickled or salted'¹¹ and Jannetta recently

⁷ Silk and Straw, p.126-28

⁸ Silk and Straw, p.121-22

⁹ Geoffrey, Immigrant, p.168

¹⁰ Morse, Day i, p.265

¹¹ King, Farmers, p.77

concluded that it was 'customary...to eat only food that was cooked.'¹² Hanley writes that 'With the exception of Japanese 'pickles', preserved by fermentation and salt, the Japanese usually ate their food cooked, so that even if night soil was improperly applied as a fertilizer, it was less likely to make everyone sick.'¹³

If foodstuffs were to be kept, they were carefully preserved using salt or pickling. Bird noted the salted fish, and also complained that vegetables were 'rendered indigestible by being coarsely pickled.'¹⁴ Such pickling would have been an extremely important way of preventing bacterial infection. As Chamberlain noted 'The food is clean, admirably free from grease, often pretty to look at.'¹⁵ The great emphasis on hygienic and careful manipulation of space, which we see applied to other aspects of Japanese material life, also applied to cooking, preservation and even the presentation of food. The famous Japanese lunch box symbolizes this attention to detail and hygiene. In the late eighteenth century Thunberg noted that food was 'served up in the neatest vessels, either of porcelain or japanned wood. These cups are tolerably large basins, and always furnished with a lid.'¹⁶ King found as he travelled on a Japanese train in the early twentieth century that 'The lunches were very substantial and put together in a neat sanitary manner in a three-compartment wooden box, carefully made from clear lumber joined with wooden pegs and perfect joints. Packed in the cover we found a paper napkin, toothpicks and a pair of chopsticks.'¹⁷ It would thus seem that every effort was made to minimize the contamination of food before it reached the mouth. The absence of flies and of animal meat no doubt helped.

The Japanese were very careful to wash their hands frequently, particularly after going to the toilet or any other 'dirty' activity. 'It is a general habit to wash hands, whenever handling anything that soils.'¹⁸ When food was being prepared, even with clean hands, it was best to avoid touching it if possible. 'What most distinguishes Japanese cooks is their extreme cleanliness. Never do they touch viands with

¹² Janetta, p.202

¹³Hanley, Sanitation (xerox), 20

¹⁴ Bird, Tracks, p.100

¹⁵ Chamberlain, Things, p.180

¹⁶Thunberg, Travels, iv, p.36

¹⁷ King, Farmers, p.375

¹⁸Khare, Ritual (xerox), 247

their fingers, but with small chop-sticks kept for the purpose.¹⁹ Hands were not clean enough for eating with: 'the Japanese still do not trust hands, even after washing, since they by definition are vulnerable to dirt - virtually no food is eaten with the fingers...Eating food and using chopsticks are inseparable; chopsticks are culturally defined as clean.'²⁰ Early travellers noted the use of 'pegs' or chop-sticks. Carletti described two sticks 'made in a round shape and blunted, the length of a man's hand and as thick as a quill for writing...They can pick up anything, no matter how tiny it is, very cleanly and without soiling their hands. For that reason they do not use tablecloths or napkins or even knives, as everything comes to the table minutely cut up...When they want to eat it, they bring the bowl it is in close to their mouth and then, with those two sticks, are able to fill their mouth with marvellous agility and swiftness.'²¹ Thunberg at the end of the eighteenth century described how 'They eat "with two lackered pegs, which they hold so dexterously between the fingers of the right hand, that they can with the greatest nicety take up the smallest grain of rice with these and these pegs serve them for the purpose both of fork and spoon.'²² Even the details of the chopsticks all added to their effects. The chop-sticks were not put into the mouth, unlike spoons in the West.²³ They were not shared 'Within the household, each member had his own set of chopsticks, rice bowl, and teacup, which no one else used...'²⁴ Disposable chop-sticks became widespread in the nineteenth century.²⁵ Even with pre-washed hands and chop-sticks, further precautions were taken. 'Not only do the Japanese insist on using chopsticks rather than hands, but they also serve an **oshibori** (a hot or cold towel) at meals with which to wipe one's hands.'²⁶

All this would add another protective layer between micro-organisms in the environment and that food which was one of their easiest routes in to the human body. Meanwhile most Asian countries ate with

¹⁹Regamey, *Art and Industry*, 184

²⁰Ohnuki-Tierney, *Illness*, 28

²¹quoted in Tannhill, *Food in History*, 267

²²Thunberg, *Travels*, iv, 36

²³Hanley, *Sanitation (xerox)*, 20

²⁴Hanley, *Sanitation (xerox)*, 20

²⁵*ibid*

²⁶Ohnuki-Tierney, *Illness*, 29

their hands, and even in supposedly 'civilized' western Europe, we are told that 'Until after 1700, although a few eccentrics used a fork for dining, most north Europeans continued to eat with fingers and knives, or spoon and bread, using them as a child does a spoon and pusher. Even as late as 1897 the British Navy was forbidden the use of knives and forks which were considered prejudicial to discipline and manliness.'²⁷

Water contamination and supplies.

Because of its climate, England is a country usually bountifully supplied with water through numerous springs, rivers, and wells. There are no obvious reasons for thinking, however, that there was anything special about these sources and the way in which water was obtained in England in general before the eighteenth century. There were numerous problems of contamination of water supplies, which grew worse as the population doubled from the later sixteenth century and began to grow rapidly again from the middle of the eighteenth century. The horrendous situation in many parts of England described in the sanitary reports of the middle of the nineteenth century cannot be projected back into earlier centuries, but they do indicate how difficult it was to obtain clean water until the latter part of the nineteenth century. For example Chadwick quotes a number of graphic accounts from health inspectors describing the foul pits, ditches and rivers which the poor were often forced to use for their water supply.²⁸

The necessity for large supplies of reasonably clean water for all sorts of purposes was widely recognized in England. The English doctor Buchan, writing in the middle of the eighteenth century, put into succinct words arguments that could be found in writings from the middle ages. Water was important for diet. 'Water is not only the basis of most liquors, but also composes a great part of our solid food. Good water must therefore be of the greatest importance in diet.'²⁹ Water was important for personal cleanliness. 'As it is impossible to be thoroughly clean without a sufficient quantity of water, we would earnestly recommend it to the magistrates of great towns to be particularly attentive to this article. Most great towns in Britain are so situated as to be easily supplied with water.'³⁰ Water was important for urban cleanliness. 'The streets of great towns, where water can be had, ought to be washed every day. This is the only effectual method for keeping them thoroughly clean; and, upon trial, we are persuaded it will be found the cheapest.'³¹ It was therefore important to procure as much, and as clean,

²⁷Tannahill, *Food in History*, xx

²⁸Chadwick, *Report*, 137, 141-2

²⁹Buchan, *Domestic*, 67

³⁰4 Buchan, *Domestic*, 105

³¹Buchan, *Domestic*, 105

water as possible. 'Before water be brought into great towns, the strictest attention ought to be paid to its qualities, as many diseases may be occasioned or aggravated by bad water; and when once it has been procured at a great expense. people are unwilling to give it up.' Yet even if English towns were situated to make the supply relatively easy, how good were the supplies?

If we start briefly with medieval England, it would appear from legislation that there was a general concern to keep water supplies clean. This was noted by Chadwick in the mid-nineteenth century. Pollution of water was dealt with by the common law, by statute law, and by manorial law. 'The corruption of the water is an offence at common law, and was early the subject of a statutory provision. In the earlier periods the power of the legislature was directly exercised for the abatement of nuisances.'³² For example 'By stat.12th Rich.II.c.13 - none shall cast any garbage or dung or filth into ditches, waters, or other places within or near any city or town, on pain of punishment by the Lord Chancellor at this discretion.'³³ As for manorial law, 'The most important, perhaps, because the most cheap and accessible authority for reclaiming the execution of the law for the protection of the subject against nuisances, for punishing particular violations of it, was vested in the Courts Leet.'³⁴ This tackles one side of the problem, the polluting of water supplies.

Equally important, particularly in cities, is the provision of an abundant supply of reasonable water. We are told that 'A piped water supply to towns was in many instances established during the Middle Ages, and certain religious orders, notably the friars, showed a conspicuous initiative in organising and constructing conduits.'³⁵ We are told that 'pipes or open conduits served Exeter, Bristol and Southampton in the fourteenth century, and Gloucester and Hull in the fifteenth.'³⁶ We can examine this provision with particular reference to the city where the problems of an adequate water supply were most acute, namely London. It appears that 'The first public cisterns, the Great conduit in West Cheap, was begun in 1285, to store the water thus brought from Paddington. By the end of the sixteenth century, some twenty conduits existed, three of which drew their supply from the Thames, and three of which are still commemorated today in the names of Great Conduit, Lamb's Conduit, and White's Conduit Streets.'³⁷ A general description of how this conduit system in the sixteenth century was

³²Chadwick, Report, 350

³³Chadwick, Report, 351

³⁴Chadwick, Report, 354

³⁵Pounds, Culture, 161

³⁶Hibbert, The English, p.103

³⁷Hardy, Water (xerox), 251

combined with wells is given by Wilson. The water supply was conveyed through the city in wooden pipes from the Thames and stand pipes were placed at street junctions from which the channels could be sluiced down each morning. When the supply was insufficient all householders who had wells of their own were required to contribute a certain number of buckets of water for this purpose.³⁸

As the city began to grow rapidly in the second half of the sixteenth century, the medieval conduits needed to be supplemented by other supplies. Of course there remained the widespread system of wells and hence it has been argued that 'until the early seventeenth century, London was largely supplied with water from shallow wells, which were sunk both in public places and in the yards and gardens of private establishments.'³⁹ Yet even this was not enough. In the 1580s a Dutch engineer, Peter Maurice, began to install a new system of water pumps driven by the force of the Thames at London Bridge. This was described by a visitor thus: 'At the end of this bridge, on the London side, is a curious machine for pumping water and for sending it into different parts of the town. This machine turns in either direction, according to the tide, so that it is always in use.'⁴⁰ Thus there were considerable improvements in the sixteenth century, with the water-driven distribution of water along wooden pipes. There is an interesting insight into the robustness of these wooden water pipes given by Peter Quennell: 'Going through Red Lion Square, Holborn, about 1930, we saw some of the old wooden water supply pipes being dug up. These were made of elm trunks, bored out to about 6 inches diameter, and according to Mr. Austin, the Holborn Surveyor, were laid about 1620.'⁴¹ Another important development in the early seventeenth century was the building of the New River. Blane thought that despite the improvements of the 1580s, 'the supply was scanty till the formation of the New River in the reign of James the First.'⁴² Yet as the city grew even more rapidly, the inadequacy of a system based on wooden pipes and the power of water itself, began to become apparent; a development then occurred which provided an escape from the dilemma.

The new system is best described by De Saussure in the early eighteenth century. 'One of the

³⁸Wilson, Shakespeare Survey, 162

³⁹Hardy, Water (xerox), 251

⁴⁰De Saussure, Foreign, 83

⁴¹Quennell, Things, iii, p.93

⁴²Blane, Dissertations (xerox), p.127; see also Heberden, Observations, p.71.

conveniences of London is that everyone can have an abundance of water.' How, we may wonder, was this possible? 'The big reservoir or cistern near Islington, the York Buildings machinery near the Strand, and that of the Bridge supply every quarter abundantly. In every street there is a large principal pipe made of oak wood, and little leaden pipes are adapted to this principal pipe, and carry water into all the houses.' As a result of this, 'Every private individual may have one or two fountains in his house, according to his means, and pays so much a year for each fountain. Water is not obtainable all day, these fountains giving three hours' water in every twenty-four. The large leaden cisterns are replenished during the time the water does not run into the houses.' 'Companies or societies have undertaken this vast enterprise and reap the profits.' Alongside this new system, there was the old. 'Besides the distribution of water by the means of pipes, there are in many streets pumps and wells, where poor people who cannot afford to pay for water can obtain it for nothing.'⁴³

How had it suddenly become possible to supply what was rapidly becoming the largest city on earth with plentiful water? We note the improved use of metal technology, the lead cisterns, the 'little leaden pipes' attached to the oak main pipes. But the real key lay in a new way of forcing the water to these more distant parts of the expanding city, which could not be reached from the old, water-driven, machine. The provision of water was one of the first fruits of the industrial revolution, namely the application of machinery based on the use of fossil fuels through steam engines.

Again De Saussure provides a good introductory account of what happened. 'I have named the York Buildings machinery. This is so curious that I must tell you more about it, for everyone understanding machinery admires it greatly....smoke issuing with force through a little tube, and corresponding with a large and tightly-covered boiler full of boiling water, sets in motion a large piece of machinery, composed of wheels, counterpoise and pendulum, which in their turn cause two large pumps to work continually. This piece of machinery and the two pumps are placed at the foot of a wooden tower, which is, I think, about one hundred feet in height, its breadth diminishing after the manner of pyramids, gradually. At the summit of this tower, which is octagonal, there is a small leaden cistern or basin, which receives the water the pumps send up, and from thence it flows into the great reservoir or pond of Marylebone.'⁴⁴ From thence it could be distributed all over a much wider area. We are told that 'The inventor of this machinery is a very clever mathematician, Dr. Desaiuguillieres, celebrated for his physical experiments and his hydraulic inventions.'⁴⁵ In other words, one of the very first uses of the new steam engine was to supply water to the great city. It was a precedent only to be followed in Paris in 1782, when 'very curious machines' raised water from the Seine by 'ordinary steam from boiling water.'⁴⁶

⁴³De Saussure, 155-6

⁴⁴De Saussure, 156-7

⁴⁵ibid

⁴⁶Braudel, Structures, 230

There was thus a rush of activity to provide piped water throughout London: a combination of steam and the development of joint stock companies. During the 1690s, for example, John Houghton F.R.S. carried a series of advertisements concerning the new conduits that were being laid. In July 1694 he commented in his editorial on the fact that while the making of the New River by Sir Thomas Middleton was a great advance, 'yet seeing we grow so very great' more was needed, which would be provided by the 'City Conduits that's now laying into Houses' which will 'make us abound not only with useful, but more pleasant waters than ever.'⁴⁷ He carried a series of advertisements urging people to join the scheme. The first of these in September 1694 was as follows: 'The Conduit water that will wash very well, and is as fine as any other whatever, and much finer than most, is to be lett, at the Black Horse and Kay against the Poultreys Compter. 'Tis brought through Pipes from Paddington, through St. James' Square, the Strand, Fleet Street, St. Paul's Churchyard, Cheapside, Lombard Street, Cornhill, and Threadneedle Street, to Bishopsgate; with a great many Bye Pipes from them. And wherever Four Persons at least, will agree to take it, within a Hundred Yards of where it now reaches, it shall be laid for them.'⁴⁸ In December he gave a much longer list of streets served, prefacing it with the remarks that 'The Fine Conduit Waters which have ever been greatly esteemed and desired of all, and by long experience approved to be the best for Washing, and all other Uses; and have served the Whole City and Suburbs many Hundred Years, being now by Act of Parliament settled for the benefit of the Orphans, are ready to be laid in the Houses of all Persons desiring the same, at reasonable rates. There are Six Main Pipes already laid into the City and Suburbs from the Conduit Heads at Paddington, Marylebone, Islington, Hoxton, Hackney and Dalston..'He added a list of five places, including the 'Conduit Office', where people could enter into agreements to receive water.⁴⁹ A further list of streets was given in October 1696, with the promise that 'more Pipes are Daily laying, and will be laid into such further other convenient Streets as shall be desired.'⁵⁰

The results were impressive. As De Saussure noted, 'The amount of water English people employ is inconceivable, especially for the cleansing of their houses.'⁵¹ In his 1756 **Essay on Waters**, Lucas

⁴⁷Houghton, Husbandry, ii, 103

⁴⁸Houghton, Husbandry, ii, no.112

⁴⁹Houghton, Husbandry, ii, 124

⁵⁰Houghton, Husbandry, iii, no.221

⁵¹De Saussure, 157

considered that London was served with water in greater variety and abundance than any city in Europe: '...there is not a considerable street in London which is not furnished with such plenty of water, by way of aqueducts or pipes, from various sources, besides what wells and pumps supply...but even the upper story of most houses are, or may be, supplied with water...' 'Common cocks in the broadest streets watered them in summer, and cleansed them in winter; the abundance of water removed the need for hawkers of water such as could be seen in Paris and other great cities.'⁵² The greater cleanliness the ample supply of water allowed may well be a significant feature in the surprising finding that cities, and particularly London, did not become unhealthier as they rapidly expanded in the eighteenth century. This water supply, Lucas believed 'is one of the causes why our capital is the most healthful great city in the world.'⁵³ As Blane observed in the early nineteenth century 'A plentiful supply of water promotes health in a great city, not only by its application to various household purposes, but by cleansing the gutters and common sewers.' He further noted that 'the ingenious machinery of the steam-engine has, since the beginning of this century, been applied for conveying and raising it [water] to the tops of the highest houses in all situations...affording a degree of abundance and accommodation in this article of life hitherto unknown.'⁵⁴ Thus by 1828 'nine London companies served some 164,000 tenants, in a city containing about 200,000 houses, and a population of about 1,500,000.'⁵⁵

The supply of large amounts of fresh water for washing and cleaning was not confined to London. In Leeds (???) 'The town had formerly been supplied from its numerous wells and by water-carts bringing a supply from the river, but in the last decade of the seventeenth century a company had been formed to supply the town with water from the Leed by means of 'an engine', one of the many joint-stock pumping enterprises undertaken at that time.'⁵⁶ In 1693 in Derby 'one Mr. George Sorocold has set up a Water-house to convey water-pipes to all the Houses in the Town that desire it, and 'tis likely it will be much used.'⁵⁷ It is likely that further research would uncover numerous other examples. Thus there do

⁵²Hardy, Water (xerox), 255

⁵³quoted in Wright, Clean, 93

⁵⁴Blane, Dissertations (xerox), p.127

⁵⁵Hardy, Water (xerox), 252: Smith, People's Health, pp.215ff provides a useful account of nineteenth-century water supplies, and Landers, Death (xerox), pp.70ff discusses London water supplies in the eighteenth century.

⁵⁶Glass (ed), Population, 340

⁵⁷Houghton, Husbandry, i, no.38

seem to be grounds for thinking that from the later seventeenth century, through a combination of technology, government encouragement and the private enterprise water companies, English cities began to gain a special advantage in relation to the supply of reasonably clean water. That this did not solve all the problems is graphically illustrated by Chadwick's survey of the 1840s. Yet even his account serves to underline how much England was already dependent on the application of the new industrial technologies to the solution of the basic need for water. It is not difficult to imagine what would have happened to urban growth from the middle of the eighteenth century if the steam-pumping of waters and the initiatives of the competing water companies had been eliminated.

Turning to Japan, there seem to have been two main supplies of water. Japan is covered by fast-flowing rivers, rushing down from the mountains to the sea. These were diverted for irrigation and for domestic use, using a variety of techniques. Morse describes a number of the methods. 'In many country villages, where the natural conditions exist, a mountain brook is conducted by a rock-bound canal through the centre of the village street; and thus the water for culinary and other purposes is brought directly to the door of every house on that street.'⁵⁸ As well as being useful, the streams added charm. 'The street was cleanly swept and in some cases the stream was bordered with beautiful little clusters of flowers or oddly shaped dwarf trees, and at intervals pretty little rustic footbridges spanned the stream.'⁵⁹ Supplementary to this, and for taking water, into the cities, bamboo was used. 'There are many ways of conveying water to villages by bamboo pipes. In Kioto many places are supplied by water brought in this way from the mountain brooks back of the city.'⁶⁰

These streams, however, were less safe than they looked. Although Kaempfer in the late seventeenth century had been impressed that the rivers which ran through Nagasaki 'provide it with clear and sweet water, very fit for daily drink,'⁶¹ the pollution of the smaller streams was noted by nearly all observers. Morse observed that 'Through these ditches the water is running, and though vitiated by the water from the kitchen and baths is yet sufficiently pure to support quite a number of creatures, such as snails, frogs, and even fishes.'⁶² The English doctor Willis described how 'In many of the villages there is a running stream down the centre of the street covered in partially in some villages and quite open in others. In a number of places the water appeared to me to be bad and unwholesome and as if containing the

⁵⁸Morse, Homes 298

⁵⁹Morse, Day, ii, 49-50

⁶⁰Morse, Homes, 299

⁶¹Kaempfer, History, 2, 90

⁶²Morse,, Homes, 52

drainage from the houses.⁶³ In the early twentieth century, Geoffrey noted the same problem. 'I have walked through picturesque villages where elaborate stone conduits led a stream past the door of every house so that each house was entered by a little wooden bridge. Here a woman would be leaning over to wash clothes, while a little bwer down another would be dipping up a bucket of water to boil for tea!'⁶⁴

The growth of Tokyo (Edo) more or less directly paralleled London and it is worth investigating in a little more depth how a city which soon became the largest in the world was supplied with water. Hanley has given a very good account of this, which I will summarize. 'In 1590, Okubo first went to Edo to assess the situation and make plans. The system he began was so large in scale and so successful that it has been compared to that of the Romans.⁶⁵ The first system to be constructed was the Kanda system which 'drew its water from the Inokashira spring east of the city. Water was carried to the city limits mainly in exposed aqueducts, and then in underground aqueducts or wooden pipes within the city.⁶⁶ Alongside this was another conduit system which took water from the Tama River, bringing much more water over a length of over fifty miles.⁶⁷ We are told that 'For its underground aqueducts, the Kanda system used square pipes of red pine, but other early systems had pipes made of other kinds of wood, stone, earth, and bamboo.⁶⁸ Access to the system was through wells. 'The public was supplied with water from wells built into the aqueduct system; people were required to go to the nearest well and draw water there rather than tap the nearest duct themselves.⁶⁹

Hanley is very impressed with the system in Edo. The system delivered water twenty-four hours a day and 'Stoppage of water was so rare that Edo-ites made no backup arrangements for emergencies.'⁷⁰

⁶³Cortazzi, Willis, 130

⁶⁴Geoffrey, Immigrant, 46

⁶⁵Hanley, Sanitation (xerox), 6

⁶⁶Hanley, Sanitation (xerox), 6

⁶⁷Idem)

⁶⁸Hanley, Sanitation (xerox), 7

⁶⁹Hanley, Sanitation (xerox), 8

⁷⁰ibid, 17

The system was so good that when it was decided to modernize it at the end of the nineteenth century, 'the only major change was to replace the wooden pipes with impervious ones metal ones. Thus, the Japanese were able to use the main features of a system constructed in the seventeenth century when converting to a water supply system based on modern technology more than two centuries later.'⁷¹ Other Japanese cities, however, 'relied on rivers and wells for their water supply.'⁷² The use of river water elsewhere is described by one early visitor thus: '...underneath this Cawsey runneth a River, at every fiftie paces there is a Well-head, fitted very substantially of free-stone, with buckets for the neighbours to fetch water, and for danger of fire. This streete is as broad as any of our streets in England.'⁷³

Apart from the running water supplied by rivers, conduits and bamboo pipes, the major form of water supply in many of the larger cities were wells and springs. The double system combining wells and aqueducts is described by Morse. 'With the exception of a few of the larger cities, the water-supply of Japan is by means of wooden wells sunk in the ground. In Tokyo, besides the ordinary forms of wells which are found in every portion of the city, there is a system of aqueducts conveying water from the Tamagawa a distance of twenty-four miles, and from Kanda a distance of ten miles or more.'⁷⁴ The scene round these sources of water is described by Alice Bacon. 'The wells and water tanks that stand at convenient distances along the streets of Tokyo are frequently surrounded by crowds of women, drawing water, washing rice, and chattering merrily over their occupations.'⁷⁵ As to the quality of this spring and well water, Kaempfer was reasonably impressed by these sources. Of the spring water in Nagasaki he wrote the water is 'very good and clear (as indeed the water is in all parts of the Empire)...'⁷⁶

In the later nineteenth century considerable efforts were made to keep the wells clean. Hearn's house was visited by 'professional well-cleaners.' He describes how 'once every year wells must be emptied and cleansed, lest the God of Wells, Suijin-Sama, be wroth.' This god 'protects all wells, keeping their

⁷¹Hanley, Sanitation (xerox), 17

⁷²ibid, 8

⁷³Purchas, Pilgrims, 153

⁷⁴Morse, Homes, 296

⁷⁵Bacon, Japanese Girls, 231

⁷⁶Kaempfer, History, 3, 68

water sweet and cool, provided that house-owners observe his laws of cleanliness, which are rigid. To those who break them sickness comes, and death.' Once a month 'a Shinto priest visits the homes of pious families having wells, and he repeats certain ancient prayers to the Well-God, and plants **nobori**, little paper flags, which are symbols, at the edge of the well. After the well has been cleaned, also, this is done. Then the first bucket of the new water must be drawn up by a man; for if a woman first draw water, the well will always thereafter remain muddy.' Not only is there a God of the well, but also he has 'little servants to help him in his work. These are the small fishes the Japanese call funa (a sort of small silver carp.) One or two funa are kept in every well, to clear the water of larvae. When a well is cleaned, great care is taken of the little fish.' Hearn found the 'water of my well is clear and ice-cold', but could never drink it again without thinking of 'those two small white lives circling always in darkness...'⁷⁷

It may well be that the water supply in Japanese cities was as good, if not better, than that in British cities of the same period. Hanley concludes that 'Water quality in Edo was better than in London in the late nineteenth century, and this at a time when the Japanese were not using impervious metal pipes.'⁷⁸ It began to improve even more towards the end of the nineteenth century in some cities. Writing in the early twentieth century, Inouye noted that 'The Tokyo municipality undertook some years ago to supply pure water, and as water-pipes have been laid throughout the city, the wells are rapidly disappearing in Tokyo.'⁷⁹ On the other hand, it is undoubtedly true of Japanese water, whether in cities or country, as it was of English, that it was full of danger until nearly the end of the nineteenth century. Bacteria would accumulate at many stages of the process of storing and conveying water.

The dangers were many, and one account of them is given by Inouye. 'As these wells have all wooden sides and a square wooden flooring where washing is done, they at present a far from cleanly appearance, and the waters is as often as not contaminated, especially in the crowded quarters of the city.'⁸⁰ Earlier, the doctor Willis had written. 'Another cause of disease is the imperfect state of the water supply, and of the drainage. In a large portion of the town the wells derive their supply of water from the surface drainage. Such water having soaked through a soil saturated with decaying organic matter is in many cases quite unfit for domestic use.'⁸¹ Morse agreed with Willis. 'It is hardly within the province of this work to call attention to the exceeding impurity of much of the well-water in Tokyo and elsewhere

⁷⁷Hearn, East, 97-8

⁷⁸Hanley, Living (xerox), 189

⁷⁹Inouye, Home, 69

⁸⁰Inouye, Home, 69

⁸¹Willis, 260

in Japan, as shown by many analyses, or to the imperfect way in which water is conveyed from remote places to Tokyo and Yokohama.⁸² As he admitted, 'In their present imperfect method of water-service it is impossible to keep the supply free from local contamination.'⁸³

A plentiful supply of relatively fresh water is immensely important in cities in allowing the cleaning of clothes, houses, streets and human bodies. It would appear that both English and Japanese cities had such a supply by the eighteenth century at the latest. This was an important achievement and will have considerable consequences on general health. On the other hand, there was no way in which water before the nineteenth century could be purified, conveyed or stored that would make it suitable for human drinking. It continued to be one of the major potential causes of enteric and other illness until the later nineteenth century. Goubert is right in arguing that the 'Conquest of Water', if by that we mean its purification so that it could be drunk safely unboiled, only occurred in the nineteenth century.⁸⁴

Yet if water was so dangerous and caused so much illness and death in the majority of early modern and developing societies, is there anything about the way in which water was drunk, or the amount that was drunk, that singles out one or both of these countries? This will take us beyond the question of water, for there are other drinks, in particular milk, which can be just as dangerous as water.

⁸²Morse, Homes, 296

⁸³Morse, Homes, 297

⁸⁴ref. Goubert XXX