Early Environmentalists and the Battle Against Sewers in Sydney

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Sharon Beder's Other Publications

Sewage pollution has reached crisis proportions in Sydney and for small towns throughout New South Wales, the introduction of a sewerage system is no longer such an attractive proposition. The alternatives put forward by groups like Friends of the Earth, which involve the use of decentralised on-site sewage treatment units placed in people's back yards, are gaining popularity over the conventional method of transportating sewage in pipes to a centralised treatment plant which discharges into the town's main waterway or the ocean. And the come-back of backyard sewage treatment is happening for the same reasons that sewers were opposed in the nineteenth century: because it is perceived that sewers lead to water pollution and waste resources.

The use of flush toilets and water to transport wastes was an old idea dating back as far as 2800 BC to the Minoans and also the Chalcolithics.[1] Despite the antiquity of such systems, referred to later as 'water carriage' systems, they were relatively new in nineteenth century Britain and were considered to be a modern, progressive method of dealing with wastes. Sanitary reform was virtually synonymous with sewer construction and Britain provided the model for Australia.

In the latter half of the nineteenth century water-carriage methods were challenged by those who preferred dry conservancy methods of dealing with the human wastes. The movement against water-carriage gained much of its impetus from community dissatisfaction with the gross environmental pollution which early sewer systems had been responsible for.

The first city sewers in Sydney were constructed in the 1850s and discharged raw sewage directly into the Harbour at Fort Macquarie (now Bennelong Point, the site of the Opera House). By 1875 there were sewage outlets at five different points in the Harbour and each was causing a nuisance. (see figure 1) A committee appointed by the Board to examine the outlets found that at Rushcutters' Bay an extensive and stinking mud flat had formed which was exposed at low tide. At Woolloomooloo Bay a large bank had formed and sewage floated on the surface of the salt water, oscillating back and forth with the movement of the tides. At Fort Macquarie a 'considerable bank' had formed and certain winds blew effluvia over 'a considerable area of the northern part of the city.' The water flowing from the Tank Stream into Sydney Cove was inky in colour, 'apparently putrescent, and floated on the surface of the Bay' for a considerable distance. Finally at Darling Harbour, the committee described accumulating banks of 'filthy and putrid mud'.[2]

The government was lobbied to clean up the mess throughout the 1870s. A petition signed by 3,800 people complained that the existing system of sewerage:

> has resulted in depositing all the filth of the city in the harbour, rendering all business occupations upon its shores disgustingly offensive, largely increasing the sickness of the citizens, and silting up year by year navigable water to a large extent. [3]

The petitioners complained that the state of the harbour was well known overseas and was 'discouraging immigration and hindering trade'. Owners of waterside properties were especially disadvantaged by having the 'excreta and offscouring of a hundred thousand people' cast upon them. 'The sewer evil' had been caused by the government and should be cleaned up by the government.[4]

Complaints had also been received from the Imperial naval authorities about the unhealthiness of the anchorage-grounds. Early in 1875 typhoid fever had broken out on board a moored 'man-of-war' ship and they attributed it to noxious gases coming from the sewer outlet at Fort Macquarie.[5]

In 1877 the Sydney City and Suburban Sewage and Health Board recommended that the city sewage be intercepted and diverted. They proposed that the north draining sewage be piped to Bondi and discharged into the sea at Ben Buckler Point and that the south draining sewage including that of Surry Hills, Redfern and Newtown be piped to a sewage farm, either on the lower part of Shea's Creek (now Alexandria Canal) near Botany Bay or on Webb's Grant on the Southern edge of Botany Bay.[6]

THE WATER-CARRIAGE DEBATE

This decision prompted public debate over the merits of water-carriage technology which was as fierce in Sydney as anywhere in the world. In a paper which was read before the Engineering Association of New South Wales in 1884 Gustave Fischer, a local civil engineer, compared the feelings on the issue to those of religious faith:

> An out-and-out water-carriage advocate would go to the stake in support of his views, while the advocates of the different systems are equally bigoted in their own way...This excessive orthodoxy...tends to make men narrow-minded and bigoted, and incapable of taking a broad and impartial view. [7]

The debate was not confined to engineers or professionals however. The newspapers regularly published editorials and letters to the editor arguing the advantages and disadvantages of water-carriage schemes and dry conservancy schemes. The issue was covered almost every day in the Herald in March 1880.

The alternatives to water-carriage technology which were put forward at the time did not include an improved cesspit system. Cesspits were not considered as a serious alternative because they were closely identified with insanitary conditions and disease. Although regulations were established to ensure that they were more adequately constructed, appropriately sited and regularly cleansed, the idea of continuing with a cesspit system was out of the question. Reforms had been called for and politically, drastic changes were required. No-one trusted the cesspit system any longer.

The dry conservancy systems which were put forward as serious alternatives included dry closets and pan systems. The dry closet (often referred to as the earth closet), named in contrast to the water-closet or flush toilet, did not use water to wash away the excrement but rather was a means of collecting the solid excrement in a container. (see figure 2) The addition of earth, ashes or charcoal after each visit to the closet deodorised the excrement which was periodically collected at night by cart and taken to a processing plant where it was dried out for use as manure.

The pan system consisted of having a pan under the toilet seat which was collected by night-men at regular intervals and replaced with an empty one. The pan was able to take urine as well as faeces and did not require the use of earth for deodorising. One version of the pan system was described at an 1889 meeting of the Engineering Association of N.S.W. by E.W.Cracknell.[8] A collection pan would be fitted to the toilet seat forming an air-tight joint which would prevent the escape of noxious gases. The full pans would be carted to a place where the pans would be emptied, washed out mechanically and returned with a measure of deodorant. The contents would be treated and made into cakes of manure. The NSW Poudrette and Ammonia Company, he claimed, already produced manure in this way at a profit.[9]

The main advantage put forward for all dry conservancy systems was their ability to utilise the waste as fertiliser. There was an element of the population in Sydney, as in Britain, that found the idea of utilising the sewage to be an attractive one. Such utilisation was already practiced informally in many parts of the world. It had been the hope of some of the early sanitary reformers that the sewage collected in sewers could be utilised on sewage farms. Edwin Chadwick, the renowned British sanitary reformer, had observed that sewage in Edinburgh was in much demand by the farmers and he persistently advocated the utilisation of sewage. At this time the Herald warned that 'We shall not always be able to rob the soil, and give it nothing in return'.[10]

Dry conservancy adherents wanted to see human wastes being utilised as fertiliser but they argued that by mixing water with sewage, as occurred in water-carriage systems, the 'constituent parts' were spoiled.[11] Moreover, they argued, the use of water-carriage technology limited the area over which fertilizer could be used whereas dry conservancy methods allowed the manufacture of poudrette cakes which could be transported where required. Dry conservancy ensured that 'the whole agricultural value of the excrement' was retained and that the resulting manure was in a form in which it could be stored and transported easily. Dry conservancy methods were also conservative of water, even if sewers were used for other household wastes, because water would not be required for toilet flushing.[12] This was no minor consideration in Sydney which had a history of inadequate water supply.

The Sanitary Reform League, originally named the League for the Prevention of Pollution of Air and Water, was formed in Sydney in 1880 to press for alternatives to the Sewage and Health Board scheme of piping the sewage to the sea at Bondi. Many of the League's members including their founder, Sir James Martin, the NSW Chief Justice, favoured dry conservancy methods and were prominent in pushing the case for dry conservancy. They criticised water-carriage as a technology that was not only wasteful but also detrimental to the environment and public health. Martin, in a series of letters published in 1880 in the Sydney Morning Herald under the heading 'The Pestilence That Walketh in Darkness', criticised the proposed scheme of sewerage because of the air and water pollution it would cause.[13] Air pollution was a particularly damning accusation since it was believed that 'miasmas' were responsible for many of the life-threatening diseases around at that time.

Sewer gas was a big problem in the nineteenth century when knowledge of how to trap the gas and prevent its return back into homes and city streets was scarce and workmanship in sewer construction often cheap and shoddy. Because of this at least one town in England, Manchester, converted from water-carriage to 'the apparently safer and more effective dry conservancy method.'[14] A letter writer to the Herald argued:

> A well sewered town may be described as supplied with a system of subterranean retorts, so arranged that the fluids in passing give off the largest volume of gases, which are carefully collected, and then by means of chimney pipes (for house drains serve admirably that purpose), conducted into the very heart of the dwellings.[15]

In many parts of the world early sewers had been built to carry off stormwater drainage and when they were converted to take sewage they did not cope very well. They were often large diameter (big enough for a person to walk through) brick construction which meant that flows were slow and sometimes stagnant. They were frequently obstructed by large objects or a build up of solids, and faulty joints permitted a substantial amount of subsoil leakage.

In Sydney it was found in 1875 that of 5,400 water closets supplied by mains water, 4,500 had a direct connection between the toilet pan and the water pipe supplying flushing water so that when the water supply was cut off, as it frequently was, toilet waste could be sucked back into the water mains. The Sewage and Health Board noted:

> The certain consequence of this most unusual arrangement is, that the water supplied to the inhabitants for household purposes is polluted with matter which some high authorities consider too offensive to be admitted even to the public sewers.[16]

The other big problem associated with water-carriage technology was the nuisance generally created at the point of discharge. Because of cost constraints and a certain measure of ignorance, and particularly because water carriage meant that there was a substantial liquid component to dispose of, most early sewers were discharged into the nearest watercourse. This rapidly led to the fouling of that watercourse which was generally quite close to the town and often the source of water supply for that town or one downstream. In Sydney it was the Harbour which was polluted and this was considered to be a public health threat because of the 'miasmas' which were coming off the harbour waters and shores.

The pollution from sewr gases and untreated discharges therefore sullied the reputation of water-carriage systems and a letter to the Herald warned:

> what a pity then, if youthful blooming Australian cities were to begrime themselves with European folly in the shape of sewage by water carriage with their inevitable melancholy train of cholera, typhus, and exhaustion of the soil.[17]

Dry conservancy methods did not have such a good image either. They were inevitably associated with the old cesspit system. Water-carriage at least removed the source of the problem from the home, quickly and efficiently. It was thought that if the sewage was allowed any time to putrefy or decompose it would give rise to 'miasmas'. Therefore if the sewage was allowed to sit around waiting for collection for the purposes of utilisation it would only cause the very problems which sanitary reform was supposed to solve. The need to remove excreta 'as speedily as possible' was readily accepted by most experts at the time[18] and was used by the Sydney sewage and Health Board to discredit dry conservancy methods:

> Such plans, moreover, all violate one of the most important of sanitary laws, which is that all refuse matters which are liable to become injurious to health should be removed instantly and be dealt with afterwards. With all these plans it is an obvious advantage on the score of economy to keep the refuse about the premises as long as possible.[19]

ARGUMENTS OVER EFFICACY

The relative merits of the various schemes being proposed were difficult to evaluate because they were all fairly new and therefore experimental. One Sydney engineer complained that almost all books and pamphlets on the subject were biased, producing 'the most hopelessly confusing discrepancies in all values and quantities.'[20] The confusion was not only because of bias but also because there was no agreed upon criterion for such an evaluation. Evaluation policies develop as a field of technology matures. When there is no agreement about competing technologies, or even the primary objectives of such technologies, as was the case with water-carriage and dry conservancy technologies, then agreement about standards and criteria of efficacy cannot be reached and the relative worth of each technology cannot be decided on the basis of 'efficacy' alone.

There were places in Australia and overseas that were using the earth-closet system to some degree but these examples were used by people on both sides of the debate to prove the success and the failure of such a scheme. It was claimed, for example, that earth closets had been used successfully in India,[21] New Jersey, Paris and Stockholm and also Balmain[22] and unsuccessfully in Balmain, Manly, Melbourne and Brisbane.[23]

Often the criticisms on both sides were based on the worst representative cases of each others schemes; dry-closets that were shared by too many people; night-soil collection that was not properly supervised or regulated; poorly constructed sewerage schemes. For example a Sydney engineer advocating water-carriage sewers, J.B. Henson, admitted that the results of many sewerage systems had been unsatisfactory but he argued, these were designed by people who did not understand sanitary principles. The Herald argued:

> It is not fair to compare the principle of water carriage, when badly worked out with that of the earth-closet system, carried out under imaginary, and in our case unattainable conditions. [24]

The debate should also be considered in the context of crisis. The tendency not to implement new systems of technology in the public sector until a crisis makes it no longer possible to put off the inevitable reforms means that such decisions are made when there is little time or flexibility for pioneering uncertain alternatives.

The relative economics of the various schemes was another hotly debated issue. The dry

conservationists argued that their schemes were more economical because of the value of the manure which would be sold, the savings in water and the lesser treatment that the remaining sewage would require. The value of the manure was a particularly indeterminate matter, and there was little agreement either on its efficacy in improving farm yields or on the price that it would fetch. Moreover the price that it could be sold for at the time did not reflect the long-term value to the soil. In the relatively young colony of N.S.W. the land had not yet been overworked and deprived of many of its nutrients and fertilisers were not as much in demand then as later. The cost of artificial fertilisers to the farmers was not considered to be a cost that should be attributed to water-carriage systems. The cost of transporting the sewage or poudrette to the farmer, however, was included in the costs of dry conservancy methods and this was one of the key factors in depriving the manure of any value. [25]

On the other hand water-carriage proponents argued that because dry conservancy methods did not deal with the large quantities of liquid household wastes, sewer systems would still have to be built and therefore the cost of dry conservancy methods were always additional to the cost of a sewerage system. This argument was made at a time when it was supposed that a combined system of drainage and sewage pipes would suffice for a city.[26] Later it was found that separate systems were required and it is uncertain how this consideration may have influenced the argument.

The operating costs of sewers discharging raw sewage into waterways were definitely lower than those of pan and dry closet systems because of the labour involved in the latter, especially when the labour required to enrich the manure and transporting it to farm land were considered. Moreover, sewerage systems were paid for on a completely different basis from cesspit, pan and dry closet systems which were paid for individually. Sewerage systems were paid for by the municipality or city and the capital cost was spread over a number of years through bond issues and loans.

However, the pan system was used in Sydney suburbs for many years, some until quite recently, as a cheaper, 'temporary' alternative to sewers. The very substantial cost of sewerage schemes made it difficult to argue for them on the basis of cost savings. However, an extensive network of sewers had been built before these debates came to the fore and the authorities baulked at starting all over and especially since this would have meant admitting that earlier decisions had been wrong as well as necessitated the scrapping of infrastructure that had required a large capital investment.

Earlier decisions had in fact set in place the beginnings of a technological system which was set to expand and grow. Such a system, as described by Thomas Hughes in his work on electricity generation,[27] encompasses not only physical equipment but also organisations, professional allegiances, legislative artifacts and scientific components. Such a system develops a momentum that is a powerful conservative force ensuring that development takes place in certain directions that were consolidated early in the system's formation. By the 1870s and 1880s the Sydney sewerage system had accumulated some organisational and financial momentum which made it difficult for dry conservationists to alter its direction.

Another, perhaps more pressing, reason for the triumph of sewers over closets and pans lies in the opportunities they offered in terms of planning and control.

ORDER, SOCIAL CONTROL & PROGRESS

The Sydney Sewage and Health Board argued that Dry Closets were unsuitable for large towns because it was practically impossible to secure proper management of the earth-closets and this was necessary to prevent the closet becoming 'a filthy and dangerous nuisance'.[28] Other management problems included getting people to apply the dry earth or ashes in sufficient quantity and detail to their excrement. A text book used in Sydney argued that 'decent people' managed their dry closets so that they were clean and inoffensive but 'the lower classes of people cannot be allowed to have anything whatever to do with their own sanitary arrangements: everything must be managed for them.'[29]

The Herald claimed that the danger with earth closets arose from the 'ignorance, the recklessness, or the neglect of the people' which could only be fixed with generations of public education, not just public organisation and regulation.[30] Dry closet enthusiasts admitted that the earth system failed in some places because 'of a want of ordinary skill or an absence of efficient supervision such as would cause any other scheme to fail.'[31] And indeed proper management was also a problem with water closets when they were first introduced:

> The ordinary water-closet is obviously unsuited for careless and wantonly mischievous people. The pans get broken, the traps choked up, the water is left running on continually from the tap, or the tap is broken and leaks wastefully; in frosty weather there is no water, and the consequence is that the closets become filthy and stinking.[32]

These problems, which were so readily blamed on the carelessness of the poor, arose because poor families were forced to share both earth and water closets with several other families and because of a lack of education about their use. An 1885 British survey found that 90% of houses inspected had broken or unflushable water closets, and five years later it was found that of 3000 houses inspected only 1% did not have plumbing or draining defects.[33]

Despite the problems with water closets, they were being installed by the affluent before water-carriage disposal systems were even available. As the most modern of conveniences they were regarded as a more desirable device. They were relatively simple and automatic to operate and they removed the offensive matter from sight and from inside the home immediately. Water-carriage systems offered more potential for control and were therefore more attractive to the authorities in Sydney and also in many other cities around the world. The visible signs of dirt and disease would be removed from the city streets once and for all and this was an important step in cleaning up and ordering the city environment.

Although the actual toilet might remain a private responsibility and therefore be subject to abuse, the automatic nature of the flush toilet removed the need for individual decision making about when and how to remove sewage from the home[34] and the collection, carriage and disposal was necessarily a centralised, government controlled activity. To achieve the same degree of control with dry closets, the Sydney Morning Herald argued, it would be necessary for delivery and collection to be by 'a process of domiciliary visitation by men armed with authority to see that this portion of the domestic arrangements of every house was properly attended to. The people would live under the visitation and supervision of an army of scavengers.'[35]

Water-carriage systems, as advocated by sanitary reformers and government authorities, required an integrated system of underground pipes that were planned, engineered and coordinated with reference to a larger, city-wide plan.[36] Political boundaries could not fragment a sewerage scheme, rather local councils were forced to give authority to more centralised government bodies in the realm of waste disposal once water-carriage systems were adopted. Water-carriage, with its scale economies, capital intensiveness and need for central administration 'was an important factor in facilitating governmental integration.'[37]

The widespread belief that progress ensued from technological change and modernisation, also linked water-carriage technology to urban progress. A writer for the Quarterley Review in England argued:

> Tube-drainage is therefore cheaper than cesspool-drainage, for the same reason, and in the same degree, that steam-woven calico is cheaper than hand-made lace. The filth and the finery are both costly, because they both absorb human toil; the cleanliness and the calico are alike economical, because they are alike products of steam-power.[38]

Sewers, despite their ancient heritage were seen to be more scientific than dry conservancy systems which seemed in turn to be somewhat primitive. Florence Nightingale observed in an 1870 Indian Sanitary Report that:

> The true key to sanitary progress in cities is, water supply and sewerage. No city can be purified sufficiently by mere hand-labour in fetching and carrying. As civilization has advanced, people have always enlisted natural forces or machinery to supplant hand-labour, as being much less costly and greatly more efficient.[39]

The progressive image of sewerage systems and their very real effect in cleaning up cities had a significant effect on the development of a city, especially where it was in competition with other cities for population and investment. The impact on health, although clear in other cities, was not so marked in Sydney until after 1880 if one considers the death rate (see figure 3). But it was generally recognised that connection to a sewerage system increased real estate values and it has been argued that businessmen in some places considered sewerage works and water supply as 'business investments in the projection of a favourable urban image.'[40]

ENGINEERS AND PROFESSIONAL CONTROL

The image of water-carriage technology as scientific and progressive was fostered by engineers whose professional image was thereby enhanced. The debate over methods of sewage collection was not confined to engineers but was readily taken up by doctors and lawyers, military men, architects and non-professional members of the public.

Water-carriage was almost universally endorsed by government officials, local councils and by the various professional groups in Sydney. The Royal Society of N.S.W. resuscitated its sanitary section in 1886 and in papers given by Trevor Jones, the City Engineer, J. Ashburton Thompson, M.D, Chief Medical Inspector, John Smail, M.Inst.C.E of the Government Sewerage Department and other doctors and engineers water-carriage sewerage systems were discussed with the assumption that they were the only solution to the problem.

The Sanitary Science and Hygiene Section of the Australasian Association for the Advancement of Science also received papers on matters concerning sewage disposal. These papers were usually given by medical men and engineers, including government engineers and university professors, who favoured the water- carriage sewerage system.

Obviously engineers did not have a monopoly of control over sanitary decisions at this stage and a person who was trained in almost any field could make their name as a sanitary expert merely by studying the issue carefully and writing about it. Engineers were however closely associated with large-scale public works, the construction of tunnels and the laying of pipes, and overseas engineers were carving out a profession for themselves in the area of sanitation. Sewers had for some time been considered to be an engineering domain.

The reform measures pushed by sanitary reformers in the nineteenth century were largely technological and the development of new technologies associated with water supply and the water-carriage of sewage offered the opportunity for a new professional group to form which claimed to have specialised knowledge in the field. Attempts were made to exclude non-engineers from the field and establish sanitary engineering as a profession distinct from other professions and associated trades. The base for sanitary engineering was civil engineering to which a knowledge of physical and natural sciences was added.[41]

At the same time medical professionals in the public health area were carving out their own area of expertise. With the changing ideas about disease causation at the end of the nineteenth century physicians tried to exclude those outside the medical profession from the field of public health and to

change the emphasis from collective community susceptibility to disease to personal and individual cure of disease with attention being given to specific agents of disease.[42] Engineers, on the other hand, retained the idea of the importance of environmental sanitation to health whilst it lent importance to their work.

Environmental sanitation fitted well with the engineering perspective which attempted to impose order on the natural environment, find technological fixes for social problems [43] and tended to view the urban environment in terms of a series of problems to be solved. The engineering priority of finding the least cost solutions, and not being swayed from that by other lesser considerations, also caused them to support the no-nonsense water-carriage system over other systems that attached some non monetary value to manure. An engineering text put it quite simply 'The all-convincing argument with any but the sentimentalist is that, while there may be manurial value in sewage, no commercially profitable method of utilizing it has been found.'[44]

The problems associated with poorly conceived and constructed sewer systems, especially the problems of seepage and sewer gas, were used by engineers to argue for more expertise to be employed with regard to sewerage systems. Water and sewerage systems, as lifelines for the city, were so important, they argued, that only professional experts should be trusted to build and administer truly comprehensive schemes of sewerage.[45]

Because water-carriage technology needed to be implemented systematically to ensure effective functioning rather than in the piecemeal or ad-hoc way that dry conservancy methods allowed, it was particularly compatible with engineering ideals since it required planning, engineering expertise and centralised management. Water-carriage systems entailed large-scale public works and large capital outlays and the engineers' association with public works, as well as their ability to minimise costs and to prioritise economic considerations, was an asset under the circumstances. Engineer-dominated permanent bureaucracies were needed to undertake the planning, construction and maintenance of water and sewerage systems. Such bureaucracies promised greater efficiency and provided the model for other types of public works.[46]

Whilst many books written by acknowledged sanitary experts in the nineteenth century devoted much space to the debate between dry conservancy methods and water-carriage systems, the texts written by engineers and for engineers were notably lacking in attention given to the debate. Such well-used texts as Latham's massive volume on Sanitary Engineering barely mention the alternatives to sewers except to dismiss them in a line or two.[47] An important exception is perhaps Colonel Waring who although a member of various engineering associations was originally trained as an agricultural scientist and probably placed a higher priority on utilisation of manure than most engineers.[48]

Government authorities were also dismissive of dry conservancy methods. An 1887 report was typical saying that 'At the best, the so-called dry systems are but inferior substitutes for water-carriage, which, if efficiently constructed throughout, is the cleanest and most convenient of all.'[49]

CONCLUSION - ANALYSIS OF A CONTROVERSY

The fight between advocates of water-carriage technology and supporters of dry conservancy technologies was an uneven one from the start. The government and the engineers who advised them generally favoured water-carriage systems because they could be controlled more easily and necessitated a centralised government bureaucracy staffed by experts. Sewers were automatic and took responsibility away from individual householders and landlords and private carters, whom, it was felt could not be trusted. Dry closets especially, depended on proper management in the home as well as regular collection and responsible disposal. Sewers removed the cause of trouble quickly and quietly from under peoples' noses.

And whilst the government could achieve sanitary reform aims, engineers saw the opportunity to establish themselves as experts in a new field of sanitary engineering and to increase their role in city management. Very few engineers participated in the newspaper debate; since this was a matter for experts, public opinion was not of much significance. Advocates of the alternative schemes, though often professional people, doctors and lawyers usually, were nonetheless outsiders since the liaison between engineers and city councils was forged early when the first sewerage systems had been built in the face of almost no opposition.

Opposition to water-carriage technology was basically value based. Opponents' central concerns were to do with pollution and conservation of resources, but these concerns were not really addressed. Debate was often focussed on technical issues of economics and efficacy. These issues could not be resolved because there were no standard criteria or test of what it meant for a system to be 'working' or effective.

People were encouraged to perceive water-closets as being clean and sewers as being the mark of progress and civilisation. The question of what to do with the sewage once it had reached its destination and the problem of subsequent pollution at the point of discharge were considered by the authorities and the engineers to be a separate and less important question and were not allowed to confuse the issue of how best to collect and remove the sewage. These problems were dealt with as they arose but the dependence of water-carriage technology on waterways for disposal has left a legacy of water pollution problems.

It is perhaps ironic that, although water-carriage technology won the day and became almost universally considered to be the superior solution to sewage removal, sewerage systems were often slow to be implemented because of their high costs and various dry conservancy methods and individualised household treatment systems (septic tanks etc.) were introduced, and have been

maintained in Sydney, even until the present day. Whilst research and development has been aimed at improving sewerage systems and centralised sewage treatment, until recently, little work has been done on improving household collection and treatment systems because of their supposed temporary nature. The latest developments in decentralised sewage treatment units are not well known and just as dry conservancy methods suffered from the association with cesspits in the nineteenth century, modern on-site treatment units today suffer from the association with the very rudimentary technologies such as septic tanks that are still around from the nineteenth century.

Endnotes

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[7] Gustave Fischer, `Water-Carriage System of Sewerage, Its Disadvantages, as applied to the Drainage of Cities and Towns', paper read before the Engineering Association of New South Wales, Sept 11, 1884, p2.

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[11] First Yearly Report of the Commissioners, p28.

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[13] Sydney Morning Herald, 9th March 1880.

[14] Anthony S. Wohl, Endangered Lives: Public Health in Victorian Britain, Harvard University Press, Cambridge, 1983, p102.

[15] Sydney Morning Herald, 15th May 1880.

[16] Sydney City and Suburban Sewage and Health Board, Progress Report, 1875, p1.

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[19] Sewage and Health Board, Third Progress Report, p6.

[20] Sewage and Health Board, Third Progress Report, p6.

[21] Burke, Sewage Utilization, pp14-21.

[22] Sydney Morning Herald, 16th March 1880, 19th March 1880, 24th March, 1880.

[23] Sydney Morning Herald, 13th March 1880, 9th April 1880

[24] Sydney Morning Herald, 13th March 1880.

[25] for a U.S. analysis of sewage as fertiliser see Joel Tarr, 'From City to Farm: Urban Wastes and the American Farmer', Agricultural History XLIX(4), Oct 1975, 598-612.

[26] for an analysis of decision-making between separate and combined systems of sewerage see Joel Tarr, 'The Separate vs. Combined Sewer Problem: A Case Study in Urban Technology Design Choice', Journal of Urban History 5(3), May 1979: 308-339.

[27] Thomas Hughes, Networks of Power: Electrification in Western Society, 1880-1930, John Hopkins University Press, 1983.

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[30] Sydney Morning Herald, 13th March 1880.

[31] Sydney Morning Herald, 19th March 1880.

[32] Corfield, The Treatment and Utilization of Sewage, p118.

[33] Wohl, Endangered Lives, p102.

[34] Joel Tarr et al, 'Water and Wastes: A Retrospective Assessment of WastewaterTechnology in the United States, 1800-1932', Technology and Culture 25(2), April 1984, p234.

[35] Sydney Morning Herald, 26th March 1880.

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