From source to sink: 'Official' and 'improved' water in Delhi, 1868–1956

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What is This?
This article examines the making of a modern colonial city through the rhetoric of ‘improvement’ and ‘progress’ in relation to water. The reference is to the history of water in the city of Delhi and what may be called ‘the first science of environment’ in a colonial urban context, with a focus not so much on the ‘extent’ of water supply and drainage, and its (in)adequacy in the colonial city, as on concerns around the ‘(im)purity’ of water, narratives of pollution, technologies of purity and the transformations they effected in a colonial context. In doing so it hopes to build upon a rich tradition of writings on urban water, its modernisation as also its location within a colonial regime, being suggestive of a framework in which we may consider water both as infrastructure and as environment, as much a network of pipes and drains as matters of pollution and well-being, as much a story of the search for and protection of the source as of the fate of the sink into which it ultimately flows.

Keywords: Delhi, urban, water, history, pollution, chemical analysis, bacteriology

Introduction: ‘Improving’ Colonial Cities

The old native rulers regarded the people simply as producers of wealth from whom the means were to be extracted of providing for the expenses, or extravagances of the court ... Much has been done in the last 20 years to convince the people that the British Government regard them in a different light, that they are no longer the property of the Government, but that the Government itself exists to promote their prosperity and well-being.¹

¹ Government of India (hereafter GoI), Annual Report on the Sanitary Administration of the Punjab, 1868, p. 36.
Colonial governmentality was a careful calibration of distancing and intervention, especially after the Ghadar of 1857. The return of tranquility, the Queen proclaimed, would be an occasion for stimulating peaceful industry and promoting works of public utility and improvement leading to prosperity, contentment and, eventually, gratitude.\(^2\) The cities of North India—Delhi, Lucknow, Kanpur—haunted by the memories of those who had been massacred or exiled, physically ruined through war and random destruction, emerged as prominent sites for realising the projects entailed in this promise, their spatial organisation and everyday routines refashioned in a bid to assure health, safety and security.\(^3\)

Troop mortality in India owed far more to disease than to war causalities and if the Empire’s security had to be maintained, the health of the troops and, by extension, the health of the residents of native towns and villages that adjoined the cantonments was paramount. ‘Even we look no further than the protection of the health of the European soldiers it will be evidently insufficient if we ... ignore the existence of the masses of the native population by which our troops are surrounded’, wrote the commissioners appointed to enquire into the cholera epidemic of 1861.\(^4\) Transformations in the arrangements through which water could be sourced and waste expelled were lodged within this double loop of civilizational mission and imperial security needs. The narrative of this transformation, not surprisingly, came accompanied by the telos of progress, echoing a more globalised dream, of piped water and drainage as an integral component of urban modernisation. Dated variously, but more or less from the middle of the nineteenth century, new centralised waterworks provided an alternative to cisterns and wells across the world, replacing the private arrangements that had linked homes to rivers and springs.\(^5\) Nationalists in many places saw in the new sanitary practices glimmers of their own modernity. None put this better than the mayor of Istanbul: ‘water shall be at our disposal in each of our houses ... The water that had been drawn with unclean hands from fountains at the corners into unclean receptacles, this water shall belong to the past.’\(^6\) Not all were persuaded though, as the colony evidently failed to mirror the metropolis, producing a fragmented rather than a universal network of public supply and disposal of water.\(^7\)


\(^3\) Oldenburg, *The Making of Colonial Lucknow*.

\(^4\) National Archives of India (hereafter NAI), Home, Public—A, No. 2–3, 5 September 1865.


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This essay examines the making of a modern colonial city through the rhetoric of ‘improvement’ and ‘progress’ in relation to water. The reference is to the history of water in the city of Delhi and what may be called ‘the first science of environment’ in a colonial urban context, with a focus not so much on the extent of water supply and drainage, and its (in)adequacy in the colonial city, as on concerns around the (im)purity of water, narratives of pollution, technologies of purity and the transformations they effected in a colonial context. This is not to understate concerns around the differential availability of water in a colonised city, but merely to underline the need for simultaneous engagement with questions of quality, in order to develop more nuanced understandings of the links between urban environments and human health as these were articulated in the colonial period. In doing so we hope to build upon a rich tradition of writings on urban water, its modernisation as also its location within a colonial regime, being suggestive of a framework which permits the simultaneous consideration of water as infrastructure and as environment, as much a network of pipes and drains as matters of pollution and well-being, as much a story of the search for and protection of the sources of water as of the fate of the sinks into which it ultimately flows.  

Narratives of Pollution and the Science of Purification

Delhi, historians inform us, lived and prospered by water intermittently over the centuries. Through the ancient period rivers, wells, tanks and baolis (step wells) met domestic and agricultural needs of the region. Increasingly from medieval times, water flowed into the city through canals leading from the river Yamuna, first built in the fourteenth century, further extended and substantially repaired in the seventeenth century. In addition, most houses had their own wells and when the canal ran dry, as indeed it did in late eighteenth century, they fell back on these wells for the supply of water. Finally, there were the kahars or mashkis, i.e., the water carriers. Households that were large enough employed their water carriers on a full-time basis; others secured their water from water carriers who visited houses with leather bags of water drawn from common wells. However, not all was right with the way the water flowed into the city, not at least in the eyes of the British who had come to occupy it in 1803. The Ali Mardan Canal had become dilapidated and dried up by mid-eighteenth century and when it was

8 For the history of modernity and urban water, see Kaika, City of Flows. For anthropological accounts of rivers and pollution in contemporary India, see Haberman, River of Love in an Age of Pollution; Alley, On the Banks of the Ganga.
9 Jacob, Jalyatra.
10 Blake, ‘Cityscape of an Imperial Capital’.
11 By 1860s, there were reportedly a thousand wells in the city, with about 600 being private and 400 public ones. The population of the city according to the Census of 1868 was 111,015.
12 Jacob, Jalyatra, pp. 31–32.

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repaired in the early years of the nineteenth century, the numerous inlets that provided fresh water to the lakes from the canals were left unattended. In 1832 a proposal was made for the repair of an underground channel to supply southeastern quarters of the city with fresh water, but remained unimplemented for lack of money. A large tank was built in 1846 to serve as a reservoir for drinking water but within a decade or so even its water had turned brackish. By mid-century, it was also apparent that the quality of the water available left much to be desired. Most of the city wells were shallow and some were within 2–3 feet of drains. One colonial official described that the mud taken from the bottom of Delhi wells was at first bluish grey, afterwards yellow, and intermixed with lotas (earthen jars), bricks and stones, and in some wells, animal bones were also to be found. An inquiry into the nature and pathology of ‘Delhi sore’ spoke of Delhi’s water as being so impure that in regard to some of the wells there were even doubts whether the analyses had been correctly printed! The drains of Delhi, the Sanitary Commissioner of Punjab wrote, were open sewers that carried away a portion of the fluid refuse, but only a part, leaving the rest to sink into the soil. To add to this, night soil that was disposed in pits posed persistent risks of polluting the subsoil near dwellings. The water received from the river and the canals in Delhi afforded little satisfaction either. Numerous drains discharged into the Western Jumna Canal whose water was used by some residents and the military cantonment for drinking, culinary and general domestic purposes. The course of the river bank, according to another report, was ‘wicked and irregular’, affording crevices for the lodgement of debris, etc., ensuring that the stream was both extremely impure and highly injurious from a sanitary point of view. To be certain, colonial officials were not alone in deprecating river-polluting practices. Gandhi, among others, was to return to this theme often and with a measure of exasperation:

Whilst I realized the grandeur of the holy Ganga and the holier Himalayas, I saw little to inspire me in what man was doing in this holy place. To my great

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13 Water from the Ali Mardan Canal flowed again into city wells by 1820, after a gap of nearly 80 years, accompanied by much merriment on part of the people of Delhi. See Gupta, Delhi between Two Empires; Mann, ‘Delhi’s Belly’, p. 7.
15 Ibid., p. 8.
16 GoI, Sanitary Administration of the Punjab, 1868, p. 27.
17 NAI, Home, Sanitary—A, No. 12–14, April 1875. Delhi, or Punjab, was hardly alone in this regard. The wells of Bombay and Calcutta, the premier colonial cities, and of Pune, Lucknow and Kanpur, housing major military cantonments, were equally considered to be sources of risk.
18 NAI, Home, Sanitary—A, No. 28–30, October 1875.
20 GoI, Sanitary Administration of the Punjab, 1868, p. 69.
21 NAI, Home, Sanitary—B, No. 9, April 1878.
grief I discovered insanitation both moral and physical ... Thoughtless ignorant men and women use for natural functions the sacred banks of the rivers where they are supposed to sit in quite contemplation and find God. They violate religion, science and laws of sanitation.\textsuperscript{22}

There was, evidently, more than one perception of pollution. (Im)purity of water, for Gandhi and many Indians, carried a double meaning, its loss of holiness symptomatic of a religious/moral crisis and its pollution causing disease. For colonial officials, however, it was only the idea of secular decline, based on ‘scientific’ evidence, through which narratives of pollution could be written.\textsuperscript{23}

In more than one inspection report, water in the town of Punjab had been pronounced good because they had been found clear and sweet to the taste. Chemical examination, however, suggested otherwise: that which was considered pure and sweet was often contaminated.\textsuperscript{24} Chemical analysis was a science in development from the mid-nineteenth century, the government having appointed a number of medical men as chemical examiners whose task was to report on the different sources of water supply and advise local authorities on the use of particular sources for drinking purposes.\textsuperscript{25} The science came accompanied with doubts, both about its need and its possibilities. On the one hand was Dr Cunningham, Sanitary Commissioner with GoI, who argued that sources of water supply that were condemned might as well have been condemned by the most cursory examination of their surroundings and of pollution to which they were manifestly exposed. A great deal more importance was being attached to the analysis of water than it really deserved; what was wanted was ‘not so much an analytical report ... but a practical report ... what we want is not further proof of contamination, but a better water


\textsuperscript{23} This is not to suggest that colonial observers were unaware of the religious significance of water for different categories of Indians. See Sharma, ‘The Circuit of Life. Water and Water Reservoirs in Pre-modern India’. However, in the period under review, M.C. Furnell, Sanitary Commissioner of Madras, offers one of the few instances where a colonial official cites extensively from the Vedas and other sacred texts of the Hindus on the art and duty of maintaining water purity. See his public lecture ‘On Water and Its Connection with Public Health’, NAI, Home, Sanitary—B, No. 40, July 1882.

\textsuperscript{24} NAI, Home, Sanitary—A, No. 96–101, April 1883.

\textsuperscript{25} NAI, Home, Public—B, No. 164–165, July 1867. In India, it needs mention, chemical analysis did not develop primarily as a science of water. On the contrary, its chief usage was for toxicological purposes and as evidence in medical trials. In this, the chemical analysts in India seem more akin to the public analysts in Britain who were expected to examine a wide range of things for contamination rather than the water examiners such as Edward Frankland who focused on water alone. See Hamlin, \textit{A Science of Impurity}. The first Chemical Examiner’s Lab in India was set up at Madras in 1849, followed by those at Calcutta (1853), Agra (1864) and Bombay (1870).
supply, that no analysis can provide’. For all ordinary purposes therefore, a ‘rough analysis’, such as that adopted by the military department, would be sufficient, provided that attention was directed at the same time to the source of supply and the probability, even possibility, of pollution. And if such an enquiry did reveal contamination of water with impure or poisonous materials, ‘all the available funds should be devoted to the provision of improved sources of supply, instead of laying them out in costly and scientific investigations and analysis by specially trained officers’, Cunningham’s ire was directed at the ‘theorists’, followers of John Snow’s water-borne theory of cholera causation led by A.C.C. DeRenzy, the Sanitary Commissioner of Punjab, who maintained that the analyses of drinking water sources would be of great value in directing enquiry to ‘real, though often not apparent, sources of corruption in drinking water supplies’. They emphasised too the effects rather than the contents of the whole exercise, such analyses being useful as an initial step towards getting a better water supply, for ‘except on competent evidence of the impurity of existing supply, local authorities will probably not stir themselves to improvement’. It was all very well to say a priori that one knew that city wells were bad and that one ought to get better. But as a rule this was not quite so well known to local authorities, and it was severely debilitating in a context where ‘natives like to have practical demonstration of the fact, and till then will cling to the hope that the water they have been using all their life is somehow an exception to the general rule’. And even if it was to be granted that existing sources of water supply were bad on mere cursory inspection, how was it to be ascertained whether the new proposed sources would be any better except through analysis. Water analysis, in this view, was a very important matter, even though its results may not always have been used most intelligently.

Those in favour of rigorous analysis seem to have found some, though limited, success. Not surprisingly, since in India, sanitation was ‘less a science than an official system’, and independent medical opinion could be trumped by high official position who ‘may dominate and intimidate the whole system’.

26 NAI, Home, Sanitary—B, No. 8–12, June 1876.
29 NAI, Home, Sanitary—B, No. 8–12, June 1876.
30 Ibid.
31 Ibid. This view, however, found less favour in the upper echelons of colonial officialdom. DeRenzy’s career was marked by humiliation and disgrace and eventual transfer from civil to military duties in Assam. Similar fate awaited other proponents of Snow’s theory such as Prof. Francis Macnamara, Professor of Chemistry at Calcutta and Chemical examiner to GoI. See Kumar, Medicine and the Raj, p. 175.
32 Hart, ‘An Address Delivered at the Opening of the Section of Public Medicine. Public Health’. Others were more optimistic, arguing that notwithstanding the theories of the Sanitary Commissioners that denied links between cholera and water, the government was convinced otherwise and was
inadequacy of working through one Chemical Examiner for several provinces, Dr T.E.B. Brown was appointed as Chemical Examiner to the Government of Punjab and Professor of Chemistry on the opening of the provincial medical school in 1860, though it was only after 1872 that the responsibility for water analysis shifted to the provincial level. Over time, the list of substances examined by him grew, from 81 cases in 1861 to 528 cases in 1872. Quite naturally, this was work for more than one person, and in 1873, Sub-Assistant Surgeon Amir Shah was appointed on probation as Assistant Chemical Examiner, his assignment being chiefly ‘analyses of water and in microscopic work’. Within a few years, however, the post was abolished on grounds of financial difficulties, leaving just one person to carry on the analysis as best as he could. The analysis carried out was fairly typical, the main reports being on hardness, solids, ammonia, chlorides, suspended matter and amount of oxygen per gallon. They had their uses but also their limits. Isolated analyses as done in India, save in exceptional cases, was of little value; occasionally it was enough to condemn the source, but in the case of ordinarily good water it was a comparative series of examinations that was needed to appreciate the rates of pollution. Majority of the samples were sent up apparently only for the purpose of knowing what the water contained with no evidence that any common measures, such as cleaning or improving the source, had been tried before an official analysis had been demanded, and there was still less any measure of reform that had followed the results of the analysis. Finally, there were theoretical differences. It was possible, the Professor of Chemistry at the Army Medical School at Netley wrote, that more was being expected from chemical analysis than the state of the science could furnish.

33 NAI, Home, Medical—B, No. 14, June 1874.
34 Ibid. One response to this shortage of staff was use private chemists as was experimented with in Bihar. However, it was held that the analysis of water was too important a matter to be left to the accident of a private practitioner, however capable, and that it would be better and more permanent plan to strengthen the establishment of the Chemical Examiner, and entrust the work to him. See, NAI, Home, Sanitary, No. 130–175, February 1897.
35 Qualitative analysis was not a problem, but the performance of quantitative work, the Chemical Examiner of Punjab wrote, required one or more skilled assistants to watch and manage tedious and often complicated processes. It was to be a full decade before the position was permanently reinstituted, with the appointment of Assistant Surgeon Guran Ditta Mal in 1885. See, NAI, Home, Medical—B, No. 68–74, June 1884; NAI, Home, Medical—B, No. 39–50, July 1886. The report describes the duties of the Assistant Chemical Examiner as ‘laborious, responsible, disagreeable and unhealthy’.
36 NAI, Home, Medical—B, No. 14, June 1874.
37 NAI, Home, Medical—B, No. 68–74, June 1884.
38 Netley is where the postgraduate training for members of the Indian Medical Service was organised. See Kumar, Medicine and the Raj, p. 130.

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its analysis there was a “war” going on between two schools of chemists.\textsuperscript{39} And as ever, there was the question of money with GoI arguing in support of Netley that there were sufficient number of officers in the Indian Medical Service qualified to undertake the work of water analysis. Their exclusive employment on such work was ‘only prevented by financial considerations’\textsuperscript{40}

This limitation of chemistry in matters of ascertaining water purity was complemented/supplemented by the emerging science of bacteriology. At its simplest, this science suggested that each disease must have its own germ and all that had to be done was to discover and define it, and then perfect the therapeutic strategies with which to cure each one of them.\textsuperscript{41} Popularised immensely after the theory had been first put forward by the German bacteriologist Richard Pfeiffer in 1892, bacteriology too saw limited developments in the course of the nineteenth century, especially in the colonies where for a significant period of time both the miasmatic and germ theories coexisted.\textsuperscript{42} By the end of the century thus, one commentator could find only two bacteriological labs worth the name in India, that of Prof. Hankin at Agra and the municipal lab run by Dr Simpson at Calcutta.\textsuperscript{43} Local conditions and resources also made a difference. The water to be examined was ideally tested as soon after collecting as possible since it tended to deteriorate and alter its condition the farther a sample had to travel.\textsuperscript{44} In colonial India, given the paucity of labs, this was frequently impossible, Delhi, for instance, having to send water samples for bacteriological analysis to the Punjab Vaccine Institute located at Lahore, 10 hours distant.\textsuperscript{45} Similarly, the use of \textit{surahis} (water containers) in India instead of Pasteur filter candles as elsewhere was likely to produce error as the material of the former was more porous and liable to permit greater passage of microbes than otherwise.\textsuperscript{46} Finally, as with chemical analysis, there was a cautionary note as to what may reasonably be expected from bacteriological analysis in the last decades of the nineteenth century and the first decades of the twentieth. It was a science ‘yet in its infancy practically, and hence not exact, nor

\textsuperscript{39} NAI, Home, Sanitary—A, No. 8–12, October 1877.
\textsuperscript{40} Ibid.
\textsuperscript{41} Tognotti, ‘Scientific Triumphantism and Learning from Facts’.
\textsuperscript{42} Harrison, \textit{Public Health in British India}.
\textsuperscript{43} Hart, ‘An Address Delivered at the Opening of the Section of Public Medicine. Public Health’.
\textsuperscript{44} Hankin, the Chemical Analyser for North-Western Provinces and Oudh wrote: ‘In all cases water to be examined must be tested as soon after collecting as possible. This is necessary because many microbes can grow and reproduce in water. Consequently if water is tested immediately after taking out of the filter well and then again some hours later, two or three times as many microbes will be found in the latter case. Care must be taken to avoid this source of error, especially in the warm weather, as microbes grow more quickly at a higher temperature.’ See NAI, Home, Sanitary, No. 130–175, February 1897.
\textsuperscript{45} Delhi State Archives (hereafter DSA), Box No. 64, CC Office, 1909. \textit{Extension of Delhi Water Works}.
\textsuperscript{46} NAI, Home, Sanitary, No. 130–75, February 1897.
applicable in many cases where exact results are demanded’. Original bacteriological research was one thing, but the application of bacteriology in practical work quite another.\footnote{Ibid.}

For the moment thus, all that was possible was to operate with multiple local standards, rather than a precise universal one. Local authorities were urged to send water for chemical and bacteriological analysis and to ‘endeavour by degrees’ to train a body of men who would be capable of carrying out on the spot the initial process of analysis, leaving the later stages to be conducted by an expert in the central laboratory equipped with the necessary appliances. Thus, in course of time, it was believed, ‘standards of purity will be worked out, and it will be possible to say whether a given sample of water conforms to the standard accepted as pure for the locality from which water comes from’.\footnote{Ibid.}

### Piped Water and Contamination in Transit

Knowing the condition of a particular source of water was one thing. Its safe transmission was quite another. Beginning with the middle of the nineteenth century, colonial officials argued, the only guardians to which the purity of water could be entrusted were ‘stone, brick and iron’. New water supply, they suggested, ‘shall be derived from such sources, and conveyed in such channels that its contamination by excrement is impossible’ (emphasis is mine).\footnote{Gol, \textit{Sanitary Administration of the Punjab}, 1868, p. 29. In rare circumstances, the pipe also evoked fear, on ‘religious’ grounds. With respect to water supply for Benares, for instance, there were some apprehensions that the anti-corrosive element in the pipe contained hog’s lard and bovine fat, a circumstance which, if correct, ‘would prevent either Mohamedans or Hindus making use of water which, according to their religious tenets, is thereby polluted and may not be used’. The government pointed out that the anti-corrosive mixture consisted entirely of gas-tar products extracted from common coal so that the story never obtained credence amongst the people of Benares. NAI, Home, Municipalities—B, No. 8–9, April 1895.} Given this proclivity towards piped water as the only source of safe water, the Delhi Municipal Committee proposed in 1869 to build a new system of water supply. The general features of this supply were easily spelt out—water would be collected from rivers, canals or such wells that were outside the town in uncontaminated soil, conveyed in iron pipes and issued from street fountains. Connection would not yet be compulsory, but owners of houses were to be afforded the facility on moderate rates.\footnote{GoI, \textit{Sanitary Administration of the Punjab,} 1868, p. 37.} The fresh alluvial soil on the banks of the Yamuna, DeRenzy suggested, would furnish an inexhaustible supply of filtered water at a very modest cost and the ridge or some of the high ground in the interior of the city would afford a convenient site for the construction of a service reservoir.\footnote{NAI, Home, Sanitary—A, No. 5–7, December 1881.} The analyst too had pronounced the
water to be ‘suitable’ though the opinion lacked sufficient detail to give any decision on the subject.\textsuperscript{52} The scheme, for one or the other reason, however, oscillated between different government departments for nearly two decades. Some officials were highly ambitious while others favoured a more modest scheme. Some argued that the scheme would be meaningful only if it included the suburbs along with the core city.\textsuperscript{53} Others preferred that no more than one-third of the supply contemplated be initially provided for, leaving further extension to future demands.\textsuperscript{54} There were continuing debates about how much water was enough water, with proposals ranging from 10 to 16 and even 20 gallons per head, then as now, there being no universal standard in this regard.\textsuperscript{55} This was also linked to the consideration whether there should be one network or a dual one, with filtered and unfiltered water being separated and used for different purposes. Techniques of filtration, either through percolation or through artificial filters, and their associated costs, were also matters of debate.\textsuperscript{56} Along with money, the necessary specialists had to be found too, the entire science of sanitation being seen as a new field with no traditional knowledge to build upon. The idea of colonial difference, evidently, was stamped at the very moment of origin of sanitary improvement in the colony:

It must not be forgotten that British municipal authorities, to whom extended powers for improving the public health were granted, had been accustomed to this work in some way under old traditions, which have no place in India. \textit{The real technical work there has to be initiated as something altogether new.}\textsuperscript{57}

\textsuperscript{52} NAI, Home, Sanitary—B, No. 61–62, October 1882.
\textsuperscript{53} NAI, Home, Sanitary—A, No. 6–8, November 1874.
\textsuperscript{54} Ibid.
\textsuperscript{55} 1 UK gallon is roughly equivalent to 5.7 litres. In Calcutta, around the 1870s, water was being supplied at 14 gallons per head and it was even recommended to take it to 50 gallons per head, which ‘after all is no very extravagant amount for such a climate’. NAI, Home, Sanitary—B, No. 67–70, September 1875. However, it was also the case that the per capita figure then, as now, masked massive inequities across various groups and localities.
\textsuperscript{56} In his counter-argument to the Public Works Department (PWD) that wanted lesser supplies per head, DeRenzy, the Sanitary Commissioner, argued that in the proposed project there was no cost of filtration since the water would be taken from wells sunk in the sandy bed of the Jumna which would act as an efficient natural filter. And even if artificial filtration were necessary, he submitted, the reduction in the supply proposed by the PWD ‘would be most injudicious and wasteful’. See, NAI, Home, Sanitary—A, No. 6–8, November 1874.
\textsuperscript{57} NAI, Home, Sanitary, No. 52 & 53, February 1888. Emphasis mine. Travel in this regard remained entirely one-way with the requirement being ‘a diffusion of the knowledge of the latest European improvements in the supply of water and drainage of towns among the existing engineering staff’, the best course for which would be ‘to frame rules that could enable Public Works officers to visit at public expense engineering works in the United Kingdom’. NAI, Home, Sanitary, No. 25–33, July 1876.

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After much deliberation and hand wringing over finances and assembling of necessary technical expertise, work on the Delhi waterworks finally began towards the end of the nineteenth century. The village of Chandraul was chosen as the site for the supply wells. Given that part of the area where the wells were proposed to be sunk was inhabited, it was advised that care be taken to cut off the immediate subsoil water from the wells themselves, the general principle being that

[The only safe rule in India is to sink wells of this class in clean ground away from the inhabited areas, and to take care that the ground is kept clear of population afterwards. The cost of additional piping is not a matter of consideration in the discussion.]

The model was a familiar one in the towns of Punjab, Lahore waterworks having been inaugurated on a similar principle, and drew upon similar sentiments in England where it was an established practice that drinking water must be drawn from sources that were entirely uncontaminated. Given these precedents, the Lt. Governor of Punjab readily agreed to the removal of the village site and its occupants to other lands.

Two sets of wells were dug in Chandraul, in 1892 and 1894, to supply water to an estimated population of 173,000 at approximately 10 gallons per head per day. Protection of the source was further supplemented by the filtration of water through natural and artificial means. The initial filtering technique adopted was a rather simple one, with the water expected to be naturally filtered as it percolated from the riverbed to the wells. The technique, however, failed fairly soon with a marked decline in the yield of the Delhi wells within a couple of years, leading the municipal committee to supplement its supply by pumping water from the river into a trench on the land side of the wells, from which the water percolated into the wells. However, this percolation too slowed down rather soon suggesting that this could be no more than a temporary remedy.

A technical inquiry into the causes of the decline was instituted and while there

59 In Lahore, water was drawn from wells sunk in the bed of river Ravi that were ‘as near to the city as was consistent with every precaution for preventing contamination through the filthy soil in and about it’. See Latif, Lahore, pp. 298–99. Indeed so great was the perceived need to keep distance between human activities and water sources that in many instances a sort of ‘wilderness preserve’ was demarcated around the new reservoirs in most cities of the Empire including Singapore, Ceylon and Hong Kong. See Broich, ‘Engineering the Empire. British Water Supply Systems and Colonial Societies, 1850–1900’.
60 DSA, Extension of Delhi Water Works.
61 However, from fairly early on it was feared that actual usage would be on a higher scale. The population figures, and the demand calculated on this, were also possibly an underestimate as new railway lines, manufacturing industries that were coming up, watering of streets and flushing of sewers were all expected to add to the demand. DSA, Extension of Delhi Water Works.
62 DSA, Box No. 51/70, W2, Commissioner’s Office, 1894. Water Supply Delhi.
were some suggestions that the shifting of the course of the river may have been responsible for the decline, for the most part the decline was attributed to the clogging of the soil between the river and the wells, itself a consequence of placing the wells too near the river channel.63 The solution offered was to construct a system of settling tanks and filters which, according to the executive engineer, should have been the scheme from the very beginning.64

Experiments by way of attaching filters to wells had already started in the 1860s, though the technology, still had its doubters.65 Even the best of filtration, in one view, would ‘never be sufficient to ... [secure] the complete removal of those subtle agents of disease, which even the most refined appliances of the chemists have failed to discover’.66 By contrast, those in favour of artificial filtration cited Dr Frankland’s submission before the Royal Commission on the London water supply in which he had argued that the polluted water of the Thames and Lea could be transformed by sedimentation and filtration into a beverage quite as good from the point of view of health as deep well water.67 The pragmatists sometimes acknowledged the arguments against filtration but maintained still that having impounded such vast amounts of water, municipalities were likely to incur only marginal extra expenditure to filter it, and so they must undertake that task in the interests of public health and to ‘set public mind at rest once and forever’.68 And even if the filters did not always work well, this could no longer be the ground for its abandonment, for that would imply letting the people ‘revert to the old plan of getting their water from wells and foul tanks as well as from the unfiltered water of the river flowing in contact with its polluted banks’.69 At any rate, as the

63 DSA, Water Supply Delhi.
64 This was based on the belief that artificial filtering of water at source was best done through sand filters where the efficient filtering agent was the layer of slime that formed on the surface of the bed, whose action was partly mechanical, but mainly biological. It was important to see that the rate of filtration was not too rapid. This was especially emphasised in India, where filtration rates were half or even a fourth of what were recommended in England and the US. DSA, Water Supply Delhi; also, NAI, Home, Municipalities—B, No. 26/27, February 1905.
65 The use of Spenser’s Magnetic Carbide Filter on the Hooghly in Calcutta was reported to have reduced the dissolved organic matter from 44 to 33 per cent. NAI, Home, Public—B, No. 175–76, 25 April 1865; NAI, Home, Public, No. 13–14, September 1866. Another report on Bombay in 1875–76 pointed out that the large amount of vegetable organic matter dissolved from the collecting area of the (Vehar) lake could be entirely removed by oxidation in passing through a filter and hoped that the municipal authority would profit by the result and complete their water supply by filtering it. NAI, Home, Sanitary—A, No. 11, December 1877. In Assam similarly, the Chief Commissioner wrote that utmost care was taken to procure water from the least impure source and to purify it by filtration before use. NAI, Home, Judicial, No. 296–316, April 1887.
68 NAI, Home, Municipalities—B, No. 12–18, October 1878.
69 NAI, Home, Sanitary, January 1892.
preliminary estimates for waterworks for New Delhi was to point in early twentieth century, the Yamuna took the natural drainage of a vast stretch out of the country and received the run-off from numerous towns, villages and nala on its banks before it reached Delhi, making its water impure anyway, necessitating sedimentation and filtration before it could be made fit for human consumption. The Delhi Municipal Committee, faced with declining quantity of water from the wells and increasing demand, was evidently happy to be persuaded in favour of artificial filtration and in 1898 decided to apply for a loan to provide filter beds, settling tanks and other necessities at Chandrawal where water would be increasingly drawn directly from the river Yamuna, which became the second, and more important, source of supply of water for the city. A powerful suction pump was erected on the bank of the river by means of which raw water was pumped up continuously into settling tanks, from where it was carried by means of underground pipes to the surface of the nine filter beds, after which it passed into two clear water reservoirs before being finally taken to the reservoir at Hindu Rao’s House on the ridge from where it was supplied by to the houses, bazaars, fort and the bungalows as well as to the numerous hydrants in the city.

The geography of pipes, however, remained uneven right through this transfer. First in line was the walled city which housed the cantonment, followed by the western suburbs and finally, the Civil Lines which, at any rate, had an adequate supply of water from the canal. By the end of the first decade a mere 146 private houses were reported to have water connections, with an overwhelming preference for the Civil Lines and Lothian Road areas that were inhabited primarily by Europeans. Additional funds were made available for the water scheme in 1898, but the suburbs of Subzimandi and Paharganj still remained excluded. By 1900–01, the extension of waterworks for Delhi was reported to be complete with filter beds and settling tank having been put in place to supplement the supply from wells. On the other hand, demands on water were ever increasing with increase in population density, falling off in the supply from wells and the canal and the need to flush new drains, the consumption of water through 2,000 private

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[70] NAI, Home, Delhi—B, No. 7–8, January 1913.
[71] DSA, Water Supply Delhi.
[72] DSA, Extension of Delhi Water Works. By the turn of the century the total capacity of water from the filter beds was reported to be 180,000 gallons, while that from the wells was 900,000 gallons daily.
[73] Hosagrahar, Indigenous Modernities, pp. 98–99. It is also important to bear in mind the nature of distinctions within Indian society, reflected in an incident in 1892 when Chamaras were banned from drawing water from the stand-posts, leaving it to the English commissioner Clarke to persuade the municipality to revoke the decision. See Gupta, Delhi between Two Empires, p. 161.
[74] NAI, Home, Municipalities—A, No. 7, February 1900. The loan was for ₹ 165,000.

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connections in 1904 reportedly being double of what it had been in 1900.\textsuperscript{76} It was also becoming clearer by the end of the decade that the filter beds that had been designed for 1,200,000 gallons daily were being used to pump nearly 2,000,000 gallons, implying that water was being forced through them without proper filtration, posing a distinct danger.\textsuperscript{77} Reports on water supply at the level of households also suggest that the declaration of ‘completion’ was a bit premature. On the one hand, the government had proceeded to equip the municipality with greater powers to enable it to carry the main arteries of supply through or under private lands and to control private connections with the main channels of supply.\textsuperscript{78} On the other, matters had reached such a state that the municipality was forced to refuse permission for new connections in certain parts of the city owing to the shortage of supply.\textsuperscript{79} Quite clearly, the water supply needed immediate augmentation and a context for it emerged in 1911, first in connection with the coronation durbar and subsequently on account of the decision to shift the capital of India to Delhi. The demand for water was expected to roughly double during the durbar and it was simply impossible to meet this requirement from the existing infrastructure. A sub-committee appointed to consider the Delhi Water Works extension scheme reported that the actual supply was 640,000,000 gallons per day which, even at 1881 population estimates, amounted to only 7.5 gallons per head. On current population estimates, the amount of water required would be roughly double that which was available! That it had not yet been called upon to meet so large a demand was simply due to the fact that the system of distribution, ‘never really complete, does not now pretend to cover the whole municipal area’.\textsuperscript{80} But quite clearly such a state of affair did not bode well for the future capital of the Empire and something would have to be done about it.

Several other developments happened around the same time, both with respect to the source and quality of water of the existing city and the planned new capital. The deputy commissioner wrote of the limited space available for the waterworks for which land had been first acquired in 1890s and which was now proving inadequate for further expansion, requesting the government to allot the newly acquired land at Metclaf House for this purpose.\textsuperscript{81} Alongside different sources of

\textsuperscript{76} Gupta, \textit{Delhi between Two Empires}, p. 166. Gupta writes that by 1900 Delhi also suffered because of the extension of the Western Yamuna Canal in different directions cutting down the district’s supply to 10 days per month.

\textsuperscript{77} DSA, \textit{Extension of Delhi Water Works}.

\textsuperscript{78} NAI, Home, Municipalities—A, No. 29–30, September 1899.

\textsuperscript{79} DSA, \textit{Extension of Delhi Water Works}. In 1905 the supply of water to the Sadr Bazar only reached as far as Deputy Ganj down the main street and it was reported that the merchants of that quarter were continually crying for a further extension.

\textsuperscript{80} DSA, \textit{Extension of Delhi Water Works}.

\textsuperscript{81} DSA, File No. 10-B, PWD, CC Office, 1913. The government agreed to the request while adding that no charge should be made for it until it was actually utilised for filter beds, etc., but when it was so utilised the municipality should pay the cost of acquisition as they supplied water to the

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water, including subsoil water, the Yamuna river (by gravitation), the Yamuna river locally (by pumping) and the Western Yamuna Canal were investigated with a view to ascertaining which would be the best source for the new (and old) city, with the eventual decision going in favour of pumping from the river Yamuna close above Delhi.82 In terms of the location of the new waterworks, extensions to the north beyond the Civil Lines were ruled out on the argument that this would not only enclose the civil station with an Indian town but also, specifically in relation to water, a large Indian settlement in this locality would endanger the purity of the water supply, the intake of which was near where the ridge joined the river. It was proposed, therefore, that pumping station and intake works be made at the northern end of the ridge above the village of Wazirabad as, upstream of this point, there were no villages for several miles abutting directly on the river on either bank and those existing in the neighbourhood of the river did not contain many inhabitants. Pollution from this source, colonial officials argued, need not be feared, ‘if the population and their arrangements were subjected to inspection from time to time’. It was understood too that, should any fear of pollution arise, ‘there would be no difficulty in arranging for the evacuation of such villages’.83 From here it was proposed to deliver the water, after settlement and filtration, to a reservoir on the ridge somewhere on the point marked 865 feet west of Talkatora garden, the rising main being utilised also for purposes of distribution, allowing for a combined supply for both Delhi and New Delhi.84 Cleanliness of source was also backed by the force of law, the Delhi municipality passing a bye-law in 1913 that stipulated a fine of ₹50 for anyone fouling the waters of wells, municipal public water tanks and the Yamuna between Majnu-ka-Tila and Metcalf House by bathing or washing, throwing animals or rubbish and filth or by allowing the water of any sink, sewer or drain, or of any steam engine or boiler, or any other filthy water belonging to him or under his control to drain or to flow so as to be likely to drain into these or any such act that may cause these waters to be fouled.85

Existing municipal waterworks were also examined for their purity. Chemical and bacteriological analysis of water was done for eight different samples—water

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82 From the records of the subsoil water available it was apparent that this source could not be relied upon to provide water in sufficient quantities locally, even with deep borings. The supply of water from the Yamuna through gravitation, it was argued, would entail both a heavy initial cost and the cost of maintenance of such a lengthy pipeline (over 130 miles), ruling out this option. The pollution of the canal water also rendered it unfit for drinking purposes, except by having recourse to filtration at a prohibitive cost. NAI, Home, Public—A, No. 62–63, July 1913.

83 NAI, Home, Delhi—A, No. 52, May 1912.


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from filter beds, water forming effluent from one of the two settling tanks, water of Yamuna river at the intake of the suction pump, water from trench wells, water from stand-post at Chandni Chowk, from stand-post at Delhi Gate, from settling tank of ‘Jewell’ filter before admixture with coagulant and filter, and filtered water from outlet at ‘Jewell’ filter. The chemical analysis suggested that well water was ‘unfit for drinking purposes’ while the bacteriological analysis showed *Balantidium coli* to be present in 5 cc but not in 1 cc of water. The microorganisms present also confirmed that many of these organisms were of excretal origin leading the report to suggest that ‘there is little need for hesitation in stating that this water should not without further purification form part of the filtered water supply of the city’. The adverse comment apart, there were also differential standards at play here. The admixture of well water with hydrant water had resulted in excessive amounts of chloride and though not a good drinking water, the report suggested, ‘it would be passed on chemical analysis in India’. River water, by contrast, was found to be a suitable water to form the basis of the city water supply and the filtered water (before it mixed with well water) was stated to be ‘for India of excellent quality’, indeed ‘it would even pass muster in England’. Regarding the ‘Jewell’ filter, the report suggested that it had rendered decidedly pure water fit for human consumption, though the degree of purity attained was not to the same degree as in the case of filter beds. Finally, pipe water was found to be worse than filtered water from the filter beds and from the outlet of the ‘Jewell’ filter but purer than well water, though at this point the report was unwilling to commit itself to the view whether the contamination had taken place at source or during distribution. Immediate remedial actions were suggested, the Health Officer of the province reporting soon thereafter that water from the wells was also being filtered with the rest of the river water making it quite pure for drinking purposes. In 1917 the slow sand filters were replaced by Patterson filters, following which the filtration and purification of water was again reported to be satisfactory.

The problem, in the view of the Sanitary Commissioner, GoI, however, was slightly different—the sand filters required scraping on an average once every week all the year round which was much too often and besides being costly was a source of serious risk of imperfectly filtered water being taken into the general supply. The cause of this was reported to be the small size of the settling tanks whereby the river water was not allowed to remain in them for a sufficiently long time for complete sedimentation of the silt to take place. Proper filtration, through adequate infrastructure, would thus have to be an immediate priority.

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86 DSA, *Extension of Delhi Water Works*. The Jewell filter had been added at the time of the Delhi Durbar.

87 Ibid.; also see, DSA, File No. 4 (119) B, Education, CC Office, 1928.

A year later the Government of India issued what it called ‘general observations’ on the further growth of water supply in which it recommended that the time had come to conduct water supply on a ‘business footing’ and water charged for ‘like any other commodity’. Regarding the kind of supply, the choice remained pragmatic. It was recognised that shallow wells, both public and private, were still in use and were likely to continue so long as piped water supply was intermittent and was drawn off hot or unpleasantly warm during the summer. Following this, in 1918 extension works were undertaken in Delhi, though there was reluctance to extend it to what was now referred to as the Old City area until such time as the reservoir at Hindu Rao’s House had been increased and new settling tanks provided at Chandrawal. Issues of contamination in transit also came up. From fairly early on it had been mentioned that the laying of water pipes in drains, sewers or passages for house sewage and sullage was ‘a sanitary crime and inexcusable’. But caution in this regard was observed more in breach than in practice and in consequence the water security promised in ‘stone, brick, and iron’ could be but partially realised in Delhi. Dr Sethna, the Medical Officer of Delhi, penned a long note on the subject, referring to various proposals that had been made, and ignored, over the years. Danger from pipes passing through drains and sewers had been mentioned as early as 1919, soon after the improvement of waterworks through the use of Patterson filters. The danger was pointed out again in 1921, based on analytical reports that even good filtered water was found to contain a very large number of lactose fermenting organisms before it reached the Paharganj area. The municipal committee resolved a year later to undertake a new programme for proper laying of water pipes but was forced to admit that absence of proper supervision and poor method of work had led to a lot of confusion, defective work and disregard of water supply bye-laws. And in 1928 Dr Sethna penned his own detailed note, detailing 206 points in the city where water mains and water pipes passed through drains, drain pits, sewers, etc., with as many as 131 cases being such that water mains and water pipes came in direct contact with sullage water. There were more than one reason for such contamination, with Sethna referring to five main causes as being: (i) the prospects for drawing in of foul air and water on account of intermittent water supply; (ii) leaky drains and leaky water pipes that ran together underground; (iii) leaky water pipes in polluted subsoil; (iv) water hydrants at practically ground level and near drain openings; and (v) house water taps being situated in close proximity of privies and drains. Several long-term

89 NAI, Home, Medical—B, No. 6–7, June 1914.
90 DSA, File No. 103, Education, CC Office, 1918. Closing of wells, in times of political strife, could also become part of a larger sense of dissatisfaction with the colonial authorities, as seems to have been the case during the Rowlatt Satyagraha of March–April 1919. See Gupta, Delhi between Two Empires, p. 204.
91 NAI, Home, Sanitary, No. 10–13, March 1879.

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and short-term measures were once again suggested and an urgent need for financial assistance by way of a loan was requested from the government. A slight increase in cholera occurred in 1928, badly laid distribution pipes were blamed yet again, and a proposal was made once again for the thorough overhauling of the distribution network. That water pipes should pass through drains and sullage taps, Deputy Commissioner of Delhi wrote on this occasion, was a matter of utter disgrace and the sooner it was put right the better it would be for the reputation of the city which was now the capital of India. Notwithstanding, a couple of years later, it was again reported that that the pipe from the reservoir near Jhandewalan was being laid through the night soil dump of the city and that there was seepage of foul water which was entering the pipes. Not surprisingly, under such conditions, it was anticipated ‘from the very start [that] this pipe will be foul and it will take a lot of trouble to clean it and disinfect it, and, moreover, it will always be liable to pollution’. In 1930, in respect to the incidence of typhoid in the city it was noted that

[T]he problem of the former faulty laying of the drinking water and sewage mains and pipes must be ultimately tackled before this sore is removed. In numerous instances water pipes were found corroded, with leaky joints and in close proximity to cracked underground drains and sewers or within polluted soil.

Enteric fever a few years later was also held to be directly on account of low sanitary standards including infection of the water supply through defective distribution pipes.

By now it was also becoming clear that the original scheme devised years ago on a stand-post system was utterly inadequate to a fast growing city like Delhi, in spite of several extensions and enlargement of branch lines. A Joint Water Board for Old and New Delhi, the Cantonment and the Notified Areas was established in 1925 and charged with all responsibilities for procuring and distributing water in various parts of the city. Hardly had it settled down that questions were raised once again regarding the scarcity of water in the city, asking the Board for relief and also requesting it to curtail, if feasible, the supply of other constituents in

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95 DSA, File No. 6 (25), Education, CC Office, 1930.
99 This was the first joint service worked out for the two municipalities. See Gupta, Delhi between Two Empires, p. 220.

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order that relief may be given to the city. The president of the Board thought it was not feasible and at any rate, in his view, there was plenty of water to go around, which was of little solace to those experiencing shortages and low pressures.\textsuperscript{100} In 1927–28, proposals were put forward to extend the water scheme to the Western Extension Area, but there was a stumbling block in that the Delhi Municipal Committee was unlikely to meet any portion of the cost, which had escalated eightfold from the time when estimates were first prepared in 1916.\textsuperscript{101} It was for the government to meet the cost, the secretary to the municipal committee argued, as ‘it was all along intended that Government should find all the capital expenditure required for the Western Extension scheme’.\textsuperscript{102} The government could not disagree more: ‘We made every possible effort to meet your wishes ... but owing to the financial outlook could not succeed ... the scheme must now be included in the revised five years’ programme ... by July next.’\textsuperscript{103} In July 1932, the Joint Water Board put up yet another scheme of water extension that involved improvement of the rising main from Wazirabad to the silt tank, construction of a second conduit from the silt tank to the Chandrawal filter beds and extension of the filter plant, with a request that this be financed partly through a free grant from the government and partly through loans.\textsuperscript{104} An estimate for laying cast iron water main from Jhandewalan Reservoir to City Extension Area was prepared in 1935 on the view that the demand for filtered water in the new city was likely to be 50 per cent in excess of the amount on which the distribution reticule had been designed, once again the request being that the cost be met by the government as this time the New Delhi Municipal Committee lacked the necessary funds.\textsuperscript{105} The population projections were going awry, the 1955 estimates having being arrived by the time of the 1931 census itself, and with it the demand for water grew exponentially. From an initial projection of 20 gallons per head, the consumption levels had risen to 25.5 gallons per head by 1935, and the demand

\textsuperscript{100} DSA, File No. 4 (35), Education, CC Office, 1925. Another complaint was that during the last Id-ul-fitr the water supply had not been kept open throughout 48 hours as had been the practice in past years.


\textsuperscript{102} NAI, Education, Health and Lands, LSG-B, No. 10–14, February 1928.

\textsuperscript{103} Ibid. However, given that the extension projects were critical to relieving congestion in the city, and given too that most of the town extension schemes in Delhi had yielded substantial profits, it eventually came around to the view that a grant-in-aid may be provided to the municipality, to be adjusted against the outlays for the proposed five year’s programme of medical and sanitary improvement. See, NAI, Education, Health and Lands, Health—B, No. 27–32, December 1929; DSA, File No. 4 (63), LSG , Local Bodies, CC Office, 1937.

\textsuperscript{104} DSA, File No. 6 (25), Education, CC Office, 1933. As expected, the government of India decline the grant component, for ‘the expenditure has to be incurred on a public utility and should be recouped from those whom the utility benefits’.

\textsuperscript{105} DSA, CC Records, File No. 4 (127) B, Education, 1936.

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for an average of 30 gallons could be anticipated, the contemporary figure for cities in England being 30–40 gallons per head.\textsuperscript{106} The government continued to exude optimism—new reservoirs were proposed at Pahari Dhiraj and Pahari Imli in 1934 and various parts of the extension scheme, except the new filters, were reported to be in place by 1937, making the pumping capacity of the Board’s Plant ‘well above all present demands’.\textsuperscript{107} The Chandrawal waterworks was extended the same year further raising the output of filtered water.\textsuperscript{108} Proposals were also made for the bulk supply of water for the industrial area, Serai Rohilla extension area and the new slaughterhouse that were coming up.\textsuperscript{109} On the other hand, in more distant villages such as Badli where the city’s refuse was being taken, the cost of piped water supply was still considered too expensive and shallow wells continued to be resorted to.\textsuperscript{110}

The water that official claimed to be supplying in adequate quantity was also presumably of sufficiently good quality; the government cited regular routine of inspection and impressive statistics for water analysis carried out by the Provincial Bacteriological Laboratory which had been set up in New Delhi in 1927 with a staff consisting of a lab assistant, a lab boy, a cleaner, a sweeper and a kahar.\textsuperscript{111} The measure devised was that the ‘Joint Water Board shall have samples of the water analyzed daily and chemicals used in the purification of the water tested when necessary by the Assistant Director of Public Health, Delhi’.\textsuperscript{112} The initial practice was of a laboratory assistant taking water samples generally from a water tap at Paharganj that was then subjected to analysis. Beginning 1928, however, samples for analysis began to be taken from stand-posts in different wards of the city.\textsuperscript{113} The lab reportedly also carried out regular examination of water samples from other sources including those taken daily from the Yamuna river, from filter beds after a dose of alum had been added, from the inspection chamber of filter after the water had passed through the filter, from pumping station after chlorination, from a tap in the Notified Area Committee Civil Lines, from two taps in

\textsuperscript{106} Bromage et al., ‘Discussion on the Sewage Disposal of Delhi ’.
\textsuperscript{107} GoI, Public Health Report on Delhi Province for the Year 1937, p. 51.
\textsuperscript{109} DSA, File No. 1/81, Local Boards, CC Office, 1941.
\textsuperscript{110} Ibid.
\textsuperscript{111} DSA, File No. 5/22, Education, 1927. A conference on the future administration of the city, just prior to the building of New Delhi, had recommended that the control of this laboratory should be provincial and that it should undertake the analysis required by the Water Board, charging the board for the work done on its behalf. NAI, Education, Health and Lands, LSG—Deposit, No. 5, January 1927. However, very quickly it was argued that as the laboratory was doing a good deal of miscellaneous work for others, the share payable by the board should be reduced. DSA, File No. 4 (32) B, Education, CC Office, 1928.
\textsuperscript{112} DSA, File No. 4 (32) B, Education, CC Office, 1928.
\textsuperscript{113} DSA, File No. 4 (119) B, Education, CC Office, 1928.
Delhi City and from three taps in New Delhi. In addition, samples were taken from the inlet and outlet of the reservoirs at Mutiny Memorial tank outlet, Jhandewala tank inlet and outlet, Talkatora tank inlet and outlet, Government House (during winter only) and Hindu Rao tank inlet and outlet on alternate days. On one day in a week, the Medical Officer of Health, Delhi City, sent six samples of water from different wards in the city. Samples from inlet and outlet of the Cantonment reservoir, Timarpur tank outlet and the taps in the villages bordering the sewage farm were also tested on a weekly basis. The total number of samples being examined on an annual basis now far exceeded what had been possible in the past decades, though with marked yearly variations, being close to 4,000 in 1936, 2,000 in 1937, 2,500 in 1938 and 1,660 in 1940.114

Faulty water supply could not, however, hide behind these impressive figures. The optimism of official speak encountered the stubbornness of disease on too frequent a basis, putting serious question marks on the assumed safety of the water being supplied to the residents of the city, especially those residing in the ‘old’ city and in the villages. The fear and fact of contamination was too frequent to provide solace, notwithstanding the optimistic official claims. Newspaper articles in 1934 commented on the widespread presence of typhoid owing to the contamination of water supply by sewage, ‘which is at present commonly the case’.115 The government begged to differ, arguing that steps had been immediately taken to put matters right.116 The problem could not be wished away, however. In April 1936, fears of contamination were yet again expressed in the press. The board was keen to protect its reputation: ‘The responsibility of the Joint Water Board is to supply water of the required standard of purity to its bulk consumers at the point of supply. Any deterioration in the quality of the water after it leaves the mains and reservoirs under the Board’s control must be the responsibility of the authority controlling the pipe lines and reservoirs through which water subsequently runs.’117 ‘To this the Assistant Director Public Health further added that even when the water in the reservoir was of very good quality, the supply in the city taps was poor, apparently due to the defects in the distribution system which, he seemed to hint, was not really the government’s lookout as the chlorination and distribution system of pipelines in Delhi City were under the control of the Delhi City municipality. On a more defensive note, the Secretary of the Water Board conceded that the method of sample taking in Delhi was not above reproach, but once again deflected the criticism to ‘lowly paid irresponsible men’

115 DSA, File No. 4/72/B/1934.
116 Ibid.
117 DSA, File No. 6 (49), Education, CC Office, 1936.
who collected the samples. The charge though was squarely refuted with the *Hindustan Times* writing that the real question was not who collected the samples but ‘what did the Health department do when these samples were found to be contaminated ...?’ The ‘lowly paid irresponsible men’ theory is an afterthought intended to whitewash criminal neglect of the duty’. Yet again, in October–November 1939 cholera occurred in the Sadr Bazar area, claiming 96 lives, leaving the government once again with the rueful observation that

> [T]he contamination of the water supply in this area, as in other areas in the City, which are still on the intermittent supply, had already been known and this outbreak has served a useful purpose in bringing the danger of such a supply before the municipal authorities.

**The Flow Away**

Water that entered the city had also to flow away, carrying along with it domestic and other wastes, in a manner calculated to do the least harm, but also tempered by fiscal considerations. In 1875, Bengal considered the possibility of risk to seamen from the flow of sewage into the Hooghly. The same year, the proposal for the conservancy of the bazaar in Simla was held up as it involved the pollution of an important stream. In 1880, concerns were raised yet again of the sewage from Fort William where the fort authorities, for no apparent military reason, still chose to pour the sewage into the river, ‘to the injury of the helpless thousands afloat below them, the decomposing excreta of nearly three thousand people’. A decade later, Bengal was on the receiving end, with authorities fearing harm to residents of the riparian towns on account of the flow of the sewage into the Ganga from Benares, Agra etc. The Government of North-West Provinces argued that there was nothing new regarding such discharge of the drainage of large towns into the river Ganga and Yamuna. If the concerns of the Bengal Government had to be taken seriously, it suggested, the Imperial Government must frame the general principles for it after full and exhaustive enquiry and without special regard to Benares or any other particular town. In the debate that ensued, three issues emerged prominently—possible difference between the rivers of India and England, distinction between sewage and sullage and with respect to the latter, the possibility of adequate treatment that would render it fit to be drained into the

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121 NAI, Home, Sanitary—B, No. 25, March 1876.
123 NAI, Home, Sanitary—B, No. 11–12, June 1880.
124 NAI, Home, Sanitary—B, No. 2–6, July 1878.
125 NAI, Home, Sanitary, No. 75–76, June 1890.
river. Based on these, what developed in the nineteenth and early twentieth century in colonial India was a fairly global conception of water bodies and their capacities to act as sinks, captured best in the notion of assimilative capacity—the ability of natural waters to absorb, dilute and disperse wastes—that promoted a controlled use of receiving waters as part of waste treatment and disposal structures. But this global conception was once again marked by colonial difference, with the degree to which perceived harms were appreciated being articulated differently in England and India.126

An early report on Delhi sewerage noted that in India ‘towns being so few, areas so great, rivers so large and their beds so different’, they were placed in a qualitatively different position than cities of Europe where the rivers had already become ‘so polluted that it may be necessary to prevent any sewerage from being emptied into them’.127 In the view of the Sanitary Commissioner of the North-West Provinces investigations and inquiries had led to a much greater value being attached to the germicidal powers of sunlight and free oxygenation such that the conclusions of the River Pollution Commission in England would have only a limited application to the circumstances of large Indian rivers, teeming with active organic life that fed on impurities and ‘flowing under an Eastern sun’.128 It followed from this line of thinking that it would be impossible to introduce into India English legislation in regard to the pollution of the rivers unless a lot more was known about the way in which Indian rivers dealt with sewage and other causes of pollution. The GoI expressed itself in favour of this view arguing that instead of a general rule, local enquiries should be made and actual testing and experimentation undertaken to ascertain whether the effect upon the water of the rivers where sewage was being discharged was such as to render it dangerous to public health.129 The question was both of principles and of practical outcomes. Would it be expedient for the government to formally concede the principle involved of passing sewage of however ‘light’ a character into a river of special character as Ganga? The answer was provided through a reference to another question, how harmful would it be? It was a well-established sanitary axiom, the Sanitary Commissioner to GoI proposed, that ‘sewage’ should not be discharged into a river, but this rule must be interpreted with ‘discretion’ and with ‘due regard to the circumstances in each case’.130 General epidemiological considerations

128 NAI, Home, Municipalities, No. 8–11, May 1898.
129 NAI, Home, Sanitary, No. 75–76, June 1890.
130 NAI, Home, Municipalities—A, No. 15–16, June 1901. The presumed distinction between sullage and sewage was as follows: the former contained rainfall and refuse water, with possible mixture of urine and decaying animal and vegetable matter, while the latter contained solid waste and excreta.
outlined by European scientists or by those based in India would not suffice, for rivers varied markedly in their bacterial and chemical contents and in their powers of self-purification, depending on the soil and the nature of the country and watershed they drained, on their volume, and on the relation of this volume to polluted water (sewage) they received, on their rate of flow, the nature of their bed and on the climate. There was also, in his view, no definite relation between the result of the chemical analysis and the pathogenic germs that they may hold in suspension, and bacteriological analysis could as a rule only provide a warning of specific pollution and could seldom demonstrate this. Under the circumstances, it would be impossible to give a scientific guarantee of harmlessness, but considering that it was sullage and not sewage whose discharge was under consideration, the natural agencies of purification could be relied on to avert harm.

As regards sewage, around the turn of the century the Sanitary Engineer and Sanitary Commissioner of Cawnpore wrote of the necessity of the biological treatment of the sewage to which attention of sanitary experts had been drawn both in England and America. Such treatment, they argued, afforded a simple, efficient and economical method of purifying sewage sufficiently to allow the resulting effluent to be discharged into a river. If it could be done on a sufficiently large scale in Indian climatic conditions, this would provide the cheapest method of getting rid of the sewage, in this instance, permitting the sewage of Cawnpore to flow by the shortest route to the low ground on the banks of the Ganga, where it could be purified and passed directly into the river. And if the process could be carried out without giving rise to offensive odours from the crude sewage during the process of purification, there was every reason to believe that the remainder of the process would be inoffensive and the resulting effluent so pure that no objection could be raised to its direct discharge into the river. The biological treatment of sewage had, however, not yet been perfected in Europe and America, and it had still to be shown that it is suited to the climate and conditions of India where it was probable that the higher temperature would be favourable to more rapid reproduction and greater activity of the bacteria. The excreta, however, was staler than in England when brought to the tanks, and it was impossible, given the current state of the knowledge, to say whether this would affect the action of the bacteria. Given the advantages offered by the biological method of treatment, both as regards efficiency and economy, they argued, it was only prudent that such knowledge be gained through the construction of experimental tanks and filter beds.131

Experimental tanks and filter beds, however, required experts who could correctly interpret the results. A strong case for the same was made at the time of considering the drainage scheme for Lucknow when it was pointed out that the chemical examiner to the Government in the United Provinces (UP) had his laboratory at Agra and thus could not carry out his examinations process in situ. The

131 NAI, Home, Municipalities—A, No. 1–2, November 1899.

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daily observation of the process was essential in order to gain authoritative knowledge, given that the alterations of temperature, humidity and evaporation had such vital effect on bacterial process. It was also important to know the quality of effluent, whether it is fit for discharge into rivers, tanks, etc., or if chemical purification was needed to supplement bacterial purification, and if so, what chemicals and in what proportions were to be added to the effluent, before such discharges could be safely made. And this applied even more to analyses for the treatment of sullage owing to its attenuated character as compared with sewage—the amount of animal matter was so small that it was difficult to set up regular bacterial action, and thus it was even more necessary to have exact knowledge of the processes. The person required did not necessarily have to be a ‘sewage expert’, but a competent sewage works chemist or analyst, of precisely similar qualifications to the chemists who were engaged on nearly all the larger sewage purification works in England to make daily examinations of the processes employed. The UP government seconded the proposal arguing that the consistency and strength of the sullage varied day by day, in fact, hour by hour, and for the satisfactory treatment of such variations it was necessary to take hourly samples of the effluents, in order to alter the bacterial process as circumstances may require and, if necessary, to further purify the effluents by chemical treatment. This was a task which only an experienced sewage chemist on the spot could undertake.132 Secretary of State, however, was far from convinced. Such a person, in his view, must be found in India itself. This was not a post that required a high degree of expert knowledge and GoI should select candidates from among persons domiciled in India and trained in the technical schools of India. Such had been the case at the time of the establishment of a sewage laboratory in Bengal in 1906 and the UP would do well to follow the Bengal example, leaving the Sanitary Commissioner with the GoI to regret that had a suitable man been appointed ‘we should have been much nearer the solution of our difficulties than we are at the present’.133

The sullage–sewage distinction and possibilities of rendering them innocuous through filtration and use of chemicals figured prominently in the different schemes outlined for the disposal of Delhi’s waste. Surface drains had been introduced by the British from the 1870s to replace the old underground Shahjahanwani drains, which emptied out into the two main subsoil sewers, the sewers in turn emptying into the Yamuna.134 One of the two main subsoil sewers ran along the length of the Chandni Chowk with the intramural surface drains from the markets and the lanes emptying into it. The other subsoil sewer encircled the city, along the path of the

134 The description in this paragraph draws upon Prashad, ‘The Technology of Sanitation in Colonial Delhi’.

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city ditch, meeting the first sewer at the Delhi Gate. Shallow surface drains collected the sullage water; sweepers flushed the drains twice a day to move the sullage along into the intramural subsoil sewer. The sewers carried the sullage to the city ditch from where sewage was discharged both into the river (along the city’s natural eastern slope) and on the sullage farms. In the initial years, authorities disputed the extent to which water in the sewers were contaminated—one the one hand, the Municipal Engineer asserted that the conservancy of Delhi was on the dry-earth system and little or no foul matter entered the sewer, while on the other, the Executive Engineer, Jumna Canal asserted that matters from the city sewers fouled his water.135 The Army Command based at Meerut agreed with the latter view arguing that the foul condition of the Selimgarh channel was mainly due to the influx of the sewer discharging the surface drainage of the Chandni Chowk and therefore suggesting that the city sewage be diverted to a point below Delhi on the downstream side of the Native Infantry Lines at Darya Gunge to the bed of the Yamuna. In time, the Delhi Municipal Committee opened the Selimgarh channel, but for the Civil Lines only and the local authorities demonstrated the discrimination that was structured into the Delhi Municipal Committee practices through a rather absurd injunction that: ‘no drainage for any native quarter will be allowed to enter Selimgarh channel’.136

Residents of Delhi were not much enthused by these new drains/sewers, as indeed was the case in many other cities of India. In the first instance, given the budgetary priorities, the construction of the drains proceeded rather slowly—by 1871, just 9 new drains had been built and 20 repaired.137 In 1893, drainage and waterworks accelerated after Delhi Municipal Committee took a loan of ₹ 9 lakhs for this purpose but most of the money was used for waterworks and the crucial subsoil sewer from Fatehpuri Masjid to Delhi Gate was only completed in 1909.138 And even here, many of the new sewers suffered from the same defects as the Shahjahani drains, having been made on the wrong principles. Surface drainage ought to have been limited to securing a smooth, well-formed, hard and easily cleansed surface with shallow saucer-shaped, impervious surface channels. Instead, it was made to include deep uncovered drains which were ‘nothing more than open trenches without the drain pipes’139 When constructed, inspection regarding the connection of houses and surface drains with the sewers, on the one hand, and supervision of house drainage, on the other, was even less of a possibility given the small supervising establishment of four to six inspectors. Complaints were frequent, with newspaper reports of the time complaining of drains that were

135 NAI, Home, Sanitary—B, No. 9, April 1878.
137 Mann, ‘Delhi’s Belly’, p. 12.
139 NAI, Home, Municipalities, No. 10–28, September 1885.

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mere gutters, containing stagnating water and emitting deadly effluvia that was ‘highly offensive to the brain’.

A few decades later the residents of Kucha Nawab Mirza Ward No. 7 were still writing to the commissioner that

[T]he open drains first constructed in this quarter have been a source of general inconvenience and a special causation of epidemics. They are always over flooded with the filthy and decaying matters and produce so horrible and poisonous a smell.... The fatal epidemic was never dreamed of by the undersigned as long as the old underground drains were existing but thanks to the new scheme they did not remain. Cholera also happens.

And still into the 1920s residents petitioned that the drainage that passed in front of the Nigam Bodh Ghat, after coming through the Kudsia Gardens, was a great nuisance to the public on account of its ‘nasty and obnoxious smell’, with the water joining the Yamuna very near the spot where the public took their bath. Occasionally there was a touch of official regret about it: ‘A part of the sullage mixed with sewage finds its way through the big drains just outside the city walls into the Jumna directly. This is not satisfactory, particularly as this sullage is mixed up with night soil.’ On the one hand, some argued that one of the first necessities for Old Delhi was a thoroughly efficient sewerage system, with underground sewers. The existing drainage system was ‘cheap and nasty’, and it would never be really sanitary ‘until it is provided with a proper system of waterborne sewage and the old cess-pools underneath the houses in the crowded centers are done away with’. On the other hand, many more functionaries of the government were of the opinion that waterborne drainage was too costly for most Indian cities. At the time of the making of the new capital city thus, the Health Officer of Old Delhi put forward the proposition that only ‘as many houses of a good class as possible’ could be connected to the sewers by way of a water carriage system. Indeed, even as late as 1930 it was pointed out that ‘for a long time to come it seems doubtful whether any but certain localities can support the expense of waterborne latrines’. New and Old Delhi quite evidently were beginning to pull apart in this regard too, with the former having an excellent drainage system, both surface and underground, while in the latter only about 20,000 persons out of a total population of 347,539 were being served by waterborne sewage system, and where there were still too many surface drains used as latrines and where sullage continued

141 DSA, Chief Commissioner’s Office, Box No. 62, File No. 179, 1907.
142 DSA, File No. 4 (40), Education, CC Office, 1928.
144 NAI, Home, Delhi—A, No. 38–41, July 1912.
145 NAI, Home, Medical—B, No. 6–7, June 1914. See also Prashad, ‘The Technology of Sanitation’.
146 DSA, File No. 29/13/1930.

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to be mixed with night soil. The sewage—sullage distinction, it is clear, had always been fictitious with reference to most of the city, but it was a fiction that commanded considerable operational weight, leaving little doubt that water that flowed directly into the river was always likely to have contained greater amount of pollution than what official reasoning would acknowledge!

Through the latter half of the nineteenth century and the first decades of the twentieth, these two issues, namely, the extent to which an improved system of drainage/sewerage, especially waterborne sewage system, could be provided, and a safe outlet for the city’s sewage and sullage found, continued to plague Delhi. In addition to the direct flow into the river, there were other sites of waste disposal and more circuitous routes of contamination, both of the river and of the groundwater. At the heart of the matter was the disposal of the night soil. An early report from the colonial period described the system:

The filth is taken from the cesspit, placed in panneries or tat bags on bullocks or donkeys and conveyed to the filth pits outside the city, 800 yards from the Lahori and Turkman gates, and there buried in trenches 5 feet deep and 8 feet wide.\textsuperscript{147}

This, over time, had become a nuisance as more was pitted than could be sold. There was also the question of lost ‘value’—it was estimated in the 1870s the value of ammonia of the intra-mural city sewage would not be less than ₹ 90,000 a year. The prospect of future municipal income was tantalising: ‘[W]hen the water-supply and sewerage schemes are finished, the Municipal Committee will have a large quantity of very valuable manure to dispose of the sale of which ought to go far towards paying the interest of the capital sunk in these works.’\textsuperscript{148} However, initial realisations were meagre, in response to which a conservancy tramway was organised so as to take the filth westwards towards the orchards near Sabzi Mandi where there was a demand for manure.\textsuperscript{149} With time, this too was deemed objectionable. In the view of the municipal committee, all that had happened was that instead of the stores of filth being within half a mile of the city, they were now about two miles away.\textsuperscript{150} Attention, therefore, turned to the khadar land (fertile fresh alluvium on the low lying floodplain) in the south-east of the city in the old Yamuna bed between Firozabad khadar and Indrapat, a large tract

\textsuperscript{147} GoI, \textit{Sanitary Administration of the Punjab}, 1868, p. 71.
\textsuperscript{148} NAI, Home, Public—B, No. 250, May 1874. Prior to the 1870s, we are told, no attempt had been made to utilize sewage in Delhi except by selling it in a dried state as fuel for burning bricks. See, NAI, Home, Public—A, No. 139–153, 7 January 1871.
\textsuperscript{149} NAI, Home, Sanitary—A, No. 42–43, September 1885. The question of the value of sewage and dry earth conservancy systems that may yield the maximum benefit were debated at length across the various parts of colonial India. See, Home, Public—A, No. 139–153, 7 January 1871.
\textsuperscript{150} DSA, Box. No. 51, Case No. S. 3, CC Office. \textit{Sewage Farm in Mauza Khadrat Kalan Delhi}. 

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of about 900 acres admirably suited for the establishment of a sewage farm, ‘being sufficiently near the city, but not so near as to be offensive, the prevailing winds blowing away from and not towards the city’. On first look there also appeared to be no objection to the khadar site as the filth deposits would not have any direct access to the Yamuna and percolation, it was felt, would be less harmful than the cultivation of melon in the actual bed of the river.

The first survey of the land suggested that no additional water would be required for irrigation, and even if the need did arise, water could be obtained from the nearby navigation canal. However, the note from the municipal committee a year down the line added a new feature. The main sewer of the city, it was reported, emptied itself into a branch of the river quite close to the fields proposed to be taken up for the sewage farm. By taking out a canal or water course at a higher level than the extreme end of the sewer, the sewage could be carried by natural flow to every field. Further, this sewer was crossed by the Western Jumna Canal at the Kabul Gate where the canal entered the city, and as the canal head was much higher than the sewer, the latter could be flushed with canal water. The water used for flushing, which would otherwise go to waste and pollute the river, the argument went, could be instead used to irrigate trenched fields.

The Government of Punjab sought further clarification. So far as they could make out, there were two distinct purposes being envisaged for the land to be acquired, namely, (i) that of a sewage farm upon which the sewage, mixed with canal water which would flow through the main drain, would be utilised and (ii) that of an area in which trenches would be dug to receive the more or less solid filth carried out from the city. And in their view, the two purposes were quite incompatible—trenching night soil and irrigating with liquid sewage could not possibly be carried out on the same piece of land. The deputy commissioner reiterated that such indeed was the case and the land would be used for both purposes together, though pointing out that the liquid sewage would be much diluted by canal water. The Government of Punjab, not entirely convinced of the virtue of this dual operation, referred the matter to the sanitary commissioner who ruled against mixing the two operations. The municipal committee now had little option but to accept this view and decided to locate the sewage farm on the south of the city at Mauza Khadrat Kalan, where it obtained water from the Okhla navigation canal.

However, as the sanitary commissioner had seen no objection to a sullage farm in Firozpur khadar, as long as it was not coupled with trenching operations, the system of selling the sullage water of the main drain to the villages in this area

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151 Ibid. Sewage farms had a long history in British India, having been started in Madras as early as 1869. NAI, Home, Sanitary, No. 12–16, November 1892.
152 Ibid.
153 Ibid.
154 Ibid.
155 Ibid.

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was persevered with, the villagers making their own ducts to take the sullage supplied to their fields. This sullage, the president of the municipal committee noted, served two purposes, namely, (i) irrigation, pure and simple, and (ii) fertilization, as it was a liquid with a distinct manurial value in it.\textsuperscript{156} The operations, however, failed to take off and by 1904 only 45 acres were reported to be under sulligation, yielding an income of approximately ₹400. The optimist view argued that more income could be made if the operations were more systematised. There were two problems that needed to be rectified: first, the intra-mural surface drainage network was inadequate for capturing the entire sullage, letting a substantial amount run to waste. Second, and perhaps even more critically, villagers knew that the committee had little choice between letting sullage run to waste and delivering it to them at such rates as they may agree to.\textsuperscript{157} Two solutions were proposed, in the form of a survey that could help in better alignment and extension, and the acquisition of an area of about 30 acres towards the river bed opposite the end of the main sewer (i.e., Delhi Gate) on which the sullage could be delivered for the purpose of raising crops or grass. However, yet one more issue remained, to get the canal department to let canal water pass down the main sewer from the Kabul Gate for delivery out at the sewer end along with the sullage, for unless the sullage was so diluted it would inevitably, in time, destroy the quality of the land that was being sulligated. The canal authorities, however, would have none of it. They just did not have the water to spare and as far as they were concerned if the municipality was keen on a sullage farm they could either use well water or obtain a continuous supply from the municipal water works.\textsuperscript{158} Commercial failure was matched by environmental nonchalance. ‘The treatment of sullage water’, as one official put it, was ‘a secondary consideration compared with the interest of the crops’.\textsuperscript{159} And such untreated water as the farm could not absorb simply overflowed into the river Yamuna.\textsuperscript{160}

Quite clearly, the first sewage/sullage farms had failed to deliver on their promise. The 1913 plan for the city, therefore, envisaged a new sewage farm at Kilokri developed over 1,250 acres, though, as with water supply schemes, discussions staggered on over a full decade before this was set up in 1926, reportedly on ‘more scientific lines than the previous trenching and sullage farms’.\textsuperscript{161} Land was leased out to cultivators on two and five year leases. Care was taken to see that vegetation of bulbous nature and those eaten raw were not grown on it but the

\textsuperscript{156} Ibid.
\textsuperscript{157} Ibid.
\textsuperscript{158} Ibid.
\textsuperscript{159} Cited in Prashad, ‘The Technology of Sanitation’.
\textsuperscript{160} Bromage et al., ‘The Sewerage of Delhi’. Bromage had served as Superintending Engineer, Health in Delhi.
\textsuperscript{161} NAI, Education, Health and Lands, LSG—Deposit, No. 5, January 1927.
constant flooding of the land soon became a serious worry. Melons, one crop that could absorb the excess water, could not be cultivated as it was feared that owing to their thin skin they would be easily contaminated. As a consequence, peasants who could not use the excess water allowed it to escape from the fields into the Yamuna through the drainage channels, where the sewage poisoned the fish. Together, the water that remained simply seeped into the soil as a result of which there was a very high organic content in the sewage farm wells that put into jeopardy a proposal to provide the surrounding villages with piped water supply. Further, the inadequacy of the sewage pumping plant resulted in the sewage heading up the main outfall and overflowing through storm water outlets into the open storm water drains in the urban areas. Technological innovations such as installation of sedimentation tanks to allow for heavier solids to deposit were made but there was little getting away from the fact that the water logging, the location of the farm near New Delhi and the fly nuisance that was ever present at a sewage farm continued to pose problems for public health officials.

In response to these concerns a scheme for extending and remodeling the sewage disposal works was proposed in December 1936 and new sewage works were brought into full operation at Okhla on 1 September 1938, designed to deal with an ultimate dry weather flow of 24 million gallons daily and three times that amount at times of rains. All storm water in excess of three times of the dry weather flow passed directly into the Yamuna which, during the rains, it was argued, had ample water and therefore prospect for adequate dilution. The purification process at the works itself was divided into three stages: preliminary sedimentation, aeration and final sedimentation, through which it was expected to produce a quality of effluent that was compatible with British Royal Commission standards. The mixed sludge from the preliminary settling tanks was drawn off through a sludge channel and dried partly by evaporation and partly by draining. A two miles long channel ran from the purification plant to the river and about 3,000 acres of land were commanded by gravity from this channel. A further 1,100 acres was irrigated by pumping. And to ensure that all was well, a chemist was deployed to maintain records showing the inlet, outlet and return sludge flows on daily and weekly basis with chemical analysis of the sludge being done for moisture content, sand, phosphoric acid and nitrogen. Results of the tests carried out on the pumping and purification side of the new plant results reportedly showed ‘appreciable

163 Prashad, ‘The Technology of Sanitation’. It was even proposed to closely monitor the water distributed to the peasants in order that they did not indiscriminately discharge sullage into the river. Also see NAI, Education, Health and Lands, LSG—Deposit, No. 5, January 1927.
164 GoI, Public Health Report on Delhi Province for the Year 1930, p. 3.
165 Bromage et al., ‘The Sewerage of Delhi’.
166 Ibid.
improvement over guaranteed contract figures’ and a large initial demand for purified sewage effluent from zamindars was reported.168 But once again, things were not going according to plan and the activated sludge process on which the plant was based continued to produce undigested sludge that invited protests from villagers situated near the new works. In the meanwhile, commerce and public health continued to duel for primacy in the colonial scheme of things. On the one hand, the Chief Health Officer of the province argued that undigested sludge was an avoidable risk and ‘any consideration of gain, profit or agricultural requirement must be secondary to the health of the people’.169 On the other, the value of the waste had to be protected, leading to a number of experiments being conducted to find means of retaining high manurial value while preventing the breeding of flies.

The question of sewage and wastewater treatment, important as it was for Delhi, also had implications for communities and economies, especially agriculture, downstream. Delhi was accused of drawing too much water at the cost of agricultural communities in Punjab and the UP. To assuage their feelings it pinned its hope on satisfactory waste treatment, hoping to return back to the Yamuna 60 per cent of the filtered water withdrawn from it ‘should certain proposals for dealing with sewage materialise’.170 Such an anticipated return was hardly appreciated by the UP government which argued that under prevailing conditions in India, in the 1920s, not more than 10–20 per cent of the filtered water could be reasonably expected to find its way back into the Yamuna after treatment. Delhi, however, stood its ground, suggesting that the views of the UP government were purely academic and not supported by actual figures! Yet again, in 1931, the irrigation department proposed the construction of a channel leading directly into the main river above the Okhla head works and the building of a brick invert for dry weather flow which would prevent the contamination of the river.171 Once again, differences of view emerged. The Nazul officer of Delhi reported that the water reaching Okhla had been greatly improved, being both transparent and without smell, and the proposed work was unlikely to improve the condition of Okhla any further. Chief Engineer of the Central Public Works Department (CPWD), however, disagreed. The complaint of the canal authorities and others interested in catching fish at Okhla, he maintained, did not concern the clear effluent that flowed into the nullah but was instead on account of the occasional doses of crude sewage which escaped in unearthed condition from Kilokri, either due to breaches in the canal or because the cultivators allowed water to escape from their field channels when it was not required. The proposed diversion of the nullah,

168 Bromage et al., ‘The Sewerage of Delhi’.
169 DSA, File No. 6 (33), LSG, Public Health, CC Office, 1940.
170 DSA, File No. 41, R&A (Revenue and Agriculture Department), CC Office, 1933.
171 Ibid.

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he proposed, would permit this sewage, should it escape again, to be discharged into the river above the canal head works where it would stand some chance of being rendered innocuous by dilution instead of being discharged below the head works where the volume of the water was small. The view seemed to have prevailed, only to pose a fresh problem in that it was feared that such diversion would possibly contaminate the water of the canal that was being used for drinking purposes by people living in the villages on the canal bank. An inquiry was ordered and, not surprisingly, Delhi again stuck to its arrangements ruling out any possible harm: ‘I do not think that there is any question of objections from villages as the Irrigation Department themselves have suggested this work and I do not think that any village depends on the Agra Canal for water for drinking purposes’, wrote the deputy commissioner.\textsuperscript{172}

Finally, there were disputes around the value of effluents and the claims of public health. On the one side were the authorities of the Agra Canal demanding that the purified effluent be first discharged into the canal whose anticipated value was be \textr 32,000 per annum, and the value to the cultivator double this amount, rather than being allowed to run into the Yamuna. There were no villages within 1.5 miles of the proposed crossing of the effluent channel over the canal and at any rate they believed that the dilution by turning purified effluent into the canal would be greater than by turning into the dried bed of the river, especially during the months of October to May.\textsuperscript{173} On the other side was the Public Health Officer of the GoI who insisted that the extent of dilution would be much less than the minimum required in England, and even under Indian conditions, would be unsafe, with the sewage containing the germs of typhoid, paratyphoid and amoebae of dysentery. There would always be risk to one group of villagers or another, either those living near the canal or those along the river. At any rate, the discharge into the river was a safer bet because over the distance of 1.5 miles of the canal there was an even flow and little of the turbulence of the river, leaving insufficient time for aeration to effect further purification.\textsuperscript{174} The canal authorities persisted, suggesting that if the effluent were taken into the Yamuna river below Okhla, there would still be no dilution worth speaking of and villages in the neighbourhood would be much more affected than those situated on the canal.\textsuperscript{175} The matter was really for the UP government to decide, GoI reckoned, whether they would be willing to expose villagers living on the bank of the canal to the risk incurred by using water that had a high percentage of a dangerous sewage effluent. The only suggestion that they could make was for the effluent to be sterilised by chlorination before it left the sewage work.\textsuperscript{176} Delhi was happy to go either way, as for

\textsuperscript{172} Ibid.
\textsuperscript{174} Ibid.
\textsuperscript{175} Ibid.
\textsuperscript{176} Ibid.
them the matter was simply that the ‘effluent has got to go somewhere’. Eventually, arrangements were made for discharging up to 12 cusecs into the effluent channel ensuring that ‘very little water will reach the river, except at times of rain’, when dilution would be possible. As a further precautionary measure a gaseous chlorine plant was also set up to treat the sewage occasionally. This combination of dilution and chlorination, the argument went, would make the effluent from the new sewage disposal works comply with the standards laid down by the Royal Commission on Sewerage not only for discharging into a river course, but also for drinking purposes.

Conclusion

The wines one imbibes, Christopher Hamlin writes, have long been a mark of class but water, at least for a time, ceased to be one of the ways in which we are unequal: ‘rich or poor, we all flushed our toilets, rinsed our mouths, and made our ice cubes with the same water’. Whatever the merits of this argument in cities of the North, it is more than evident that colonial cities found it far more difficult to secure the universal ‘we’ as drinking water remained inadequate, being neither universal nor fully secure. The hopes reposed by colonial engineers in brick and mortar, scientific standards and technological interventions, as the guarantor of water in sufficient quantity and of good quality, both at points of access and moments of discharge, failed to materialise as fiscal conservatism dictated pragmatic choices and spatial distinctions. Delhi’s water, we suggest, was subject to the same play of colonial difference as other schemes of improvement were to be and what emerged in the wake of a century’s efforts at improvement was a city and a capital, adjacent in space but destined towards different futures.

Nor did the hopes of realising Royal Commission standards in matter of discharge materialise. The river Yamuna flooded in October 1955, followed by a serious outbreak of jaundice in December–January 1956. The report of the official committee appointed to inquire into the incident confirmed that the source of the disease had been the contamination of river water by the overflow of sewage from the Najafgarh drains sometime between 4 and 16 November. This,

177 Ibid.
178 Bromage et al., ‘The Sewerage of Delhi’. Money matters were never too far here either and it was suggested that chlorination being an expensive business, the recurrent cost could be curtailed if the effluent was treated ‘only when its discharge into the river is likely to cause a real problem’. DSA, File No. 161-B, R&A, Dept., CC Office, 1937.
180 Hamlin, ‘Waters’ or ‘Water’?
181 GoI, Report of the Jaundice Committee, pp. 5, 21. The report of the committee constituted for the purpose of inquiring how far the pollution of Yamuna water during November 1955 was responsible for the outbreak of jaundice in Delhi in the subsequent two months, 1956. For more details on this outbreak see Hindustan Times, 4 January 1956; 8 January 1956.

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according to the report, was the ‘first instance in the world of a piped municipal water supply being responsible for a large-scale dissemination of the virus’. Indeed, it is entirely possible that on 14 and 15 November people in Delhi were drinking half sewage and half river water, leading one Member of Parliament to acerbically remark that the name ‘Joint Water and Sewage Board’ was quite apt! Nearly a century of official effort had gone into the making of a piped water supply as a security against the consumption of polluted water drawn from traditional wells and other sources. Ironically, the same modern system was the source of an altogether new risk!

Following the jaundice epidemic, engineering works and planning were recommended and till date our approach to urban water continues to draw upon this tradition. The bias in favour of the elite sections of the city persists, even as the native has yielded to the migrant and the illegal. Ironically, this may have gained a even greater fillip as the rhetoric of safe water no longer convinces and in a curious return to history private filtering technologies that were to have become redundant in the era of public filtered water supply have made a significant return with filtration and chlorination now combined with Reverse Osmosis (RO) and UV technologies. Equally significantly, many elements of contemporary policies continue to be in favour of the same technological solutions that were first offered during the colonial period—the confidence in securing water through large engineering works, from ever more distant sources, has taken some knocking but is still very much on the official agenda; the belief in effecting better health, of humans and the river alike, through capital-intensive and centralised sewage treatment plants persists, even as some questions are being raised about the efficacy of such measures.

However, there has also been a slow and subtle transition. The assimilative capacity approach—the assumption that science can provide policy makers with the information and means necessary to avoid encroaching upon the capacity of the environment to assimilate impacts, the presumption of availability of relevant technical expertise when environmental harm is predicted and the belief that there would be sufficient time to act in order to avoid such harm—is no longer convincing as a strategy of tackling pollution. In its place we witness instead the emergence of a new principle of regulation, relying on anticipation and precaution rather than after-the-fact interventions. The Supreme Court had observed in A.P. Pollution Board,

The Precautionary Principle is based on the theory that it is better to err on the side of caution and prevent environmental harm which may indeed become

183 Hindustan Times, 13 March 1956.
184 ‘Pure Myth’, Down to Earth.
irreversible. The principle of precaution involves the anticipation of environmental harm and taking measures to avoid it or choose the least environmentally harmful activity ... Environmental protection should not only aim at protecting health, property and economic interest but also protect the environment for its own sake.\footnote{Supreme Court of India, A. P. Pollution Control Board vs. Prof. M.V. Nayudu. Judgement dated 27 January 1999.}

The implications of this transition are several, as guided by the potentiality of ‘irreversible damage’, we have begun to revise our notions of ‘adequate’ proof of harm, our judgements regarding the appropriate moment of intervention (before or after a harm) and have started shifting the burden of proof from the victim to the polluter.\footnote{The writings on this theme are several. See, for instance, McIntyre and Mosedale, ‘The Precautionary Principle as a Norm of Customary International Law’; Resnik, ‘Is the Precautionary Principle Unscientific?’ and Sunstein, ‘Precautions and Nature’.} Together, these have the potential to ensure that the source and the sink which were only inadequately combined in the colonial arrangement of things can now be brought closer together. In other words, to borrow a phrase of popular coinage, help us realise that we all live downstream!

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