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SEWERAGE IN ANCIENT AND MEDIAEVAL TIMES*

By Harold Farnsworth Gray

Sanitary and Hydraulic Engineer, Berkeley, Cal.

We frequently hear people speak of "modern sanitation" as if it were something rather recently developed, and there appears to be a prevalent idea that municipal sewerage is a very modern thing that began some time about the middle of the last century. Perhaps these ideas do something to bolster up a somewhat wobbly pride in modern civilization (concerning the inherent values of which some have their doubts), but when examined in the light of history these ideas are seen to be far from new or even recent. Indeed, in the light of history it is a matter of astonishment, if not chagrin, that man in this respect has progressed so very little, if at all, in some four thousand years.

The Mesopotamian Empires of Assyria, Babylonia, and their antecedent Sumerian and Akkadian states, marked great advances in civilization. An example is the city of Eshnunna, located about 50 miles northeast of the present Baghdad. The ruins of Eshnunna have been excavated by the Oriental Institute of the University of Chicago. These excavations exposed sewers constructed of brick, with laterals connecting to water-flushed latrines in the houses. Eshnunna is dated about 2500 B.C., or about the reign of Sargon I. But archeological researches in the past twenty or thirty years have yielded a considerable amount of of information concerning other communities either contemporary with, or antedating, the Assyrians and the Babylonians. In these other communities the art of sanitation had reached a development which might even shame some of our modern towns of similar size. At least two of them are so notable in their sanitary achievements as to be worth a brief examination. They are the Indus civilization of about 2550 B.C., and probably much earlier, and the Aegean civilization of about 3400–1200 B.C.

The Indus civilization is best known through the excavation of Mohenjo-daro, "The Mound of the Dead," which is located in Sind, about 25 miles from Larkana town, and almost due north from Hyderabad about 130 miles. A similar and larger ruin, Harappa, is located some 400 miles northeast of Mohenjo-daro, and in this general area between Mohenjo-daro and Harappa there are numerous mounds indicating other cities of this same Indus culture, and in addition there are mounds of an even earlier and distinct Amri culture.

The upper levels of Mohenjo-daro are dated about 2550 B.C. The lower levels probably go back much further, but high ground water has prevented effective excavation into these earlier cities. The mounds above the ruins average 20 to 30 feet in height (with a maximum of 70

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feet) and cover an area of about 240 acres, but floods and erosion have probably greatly reduced the original extent of the ruins.

These Indus people had a highly developed chalcolithic (stone implements contemporary with copper or bronze) culture which was similar to and in some respects superior to the contemporary Mesopotamian and Egyptian culture. They were organized into cities, with a well developed commerce in all directions. They had wheeled vehicles for transport. They were skilled metal workers, using gold, silver, copper and lead, and tin in bronze. They made cotton into textiles. They had domesticated the dog, pig, sheep, buffalo, humped zebu, camel and elephant, but probably not the horse or cat. They had well-built and commodious houses, and baths, with drainage systems built of well-burned brick, and the common people probably enjoyed a degree of comfort unknown in other parts of the world, for in other contemporaneous civilizations the skill of the artist and builder was lavished upon the temples and palaces, but the homes of the ordinary people were apparently inadequate and ephemeral hovels.

Furthermore, the Indus civilization as known by present excavation was already old at 2500 B.C., and was not an incipient civilization, for there are several other levels, one below the other, of earlier cities, and in the lower levels the workmanship appears to be even better than in the upper-most level.

Practically every house in Mohenjo-daro had its bathroom, always placed on the street side of the building for the convenient disposal of waste water into the street drains. Where latrines have been found in the houses, they were placed on the street wall for the same reason. Ablution places were set immediately adjacent to the latrines, thus conforming to one of the most modern of sanitary maxims. Where baths and latrines were located on the upper floor, they were drained usually by vertical terra-cotta pipes with closely fitting spigot joints, set in the building wall.

These ancient terra-cotta pipes, still sound after nearly five thousand years, are the precursor of our modern vitrified clay spigot-and-socket sewer pipe, and are an excellent guarantee of the durability of this material.

Houses also had rubbish chutes built into the walls and descending from the upper floors, at the foot of which chutes there were sometimes provided bins at the street level which could be cleaned out by the scavengers. Public rubbish bins were also provided at convenient places.

The bath and kitchen waters, as well as drainage from the latrines, and the roof drainage, usually did not run into the street drains direct, but entered them via tightly brick-lined pits, with outlets to the street drains about three-quarters of the distance above the bottom. Apparently these pits were cleaned out from time to time, as were the settling basins or soakage pits located along the street drains. These pits may have been the ancient precursors of our present day septic tanks and grit chambers. In some houses the drainage water discharged into

large pottery jars placed in the street at the foot of the vertical drains in the street walls.

Each street and lane had one or two drainage channels, with brick or stone covers which could be lifted to remove obstructions in the drains. The drains were usually 18 inches to 24 inches below the street level, and varied in dimensions from 12 inches deep and 9 inches wide to about 24 inches deep and 18 inches wide. When the drain could not be covered by flat bricks, or stone slabs, the roof of the drain was corbelled.

The principal community bath was a structure of considerable size, conforming somewhat with our ideas of a swimming pool, though perhaps being used rather as a place for religious ceremonials than for either mere pleasure or for only the cleansing of the body. The structural features of the pool indicate an excellent ability in construction, considering the building materials available at that time and place. For example, waterproofing was accomplished by a membrane or coating of asphaltum between the inner and outer walls of the pool or tank.

Many of the homes had their individual wells within the buildings. These wells were usually circular in plan, though at times oval, and had copings of stone or brick at the floor level, and brick lining for a moderate depth below the surface. In a few instances the street drains ran rather too close to the wells, and it is possible that some contamination of the well occurred. But in most cases the wells were located at adequate distances from the drains.

Considered as a whole, the Mohenjo-daro ruins present a picture of a community in which both personal and community cleanliness was quite effectively practiced, and the water supply reasonably safeguarded from contamination as a rule.

But lest it be assumed that the prehistoric Indus civilization was a rare and unusual thing, let us examine the nearly contemporaneous and very remarkable civilization which flourished around the Aegean Sea about 3000–1000 B.C. It is shown in its highest development in the ruins of the Palace of Minos near Knossus on the Island of Crete.

The Minoans were builders of splendid palaces of stone; they constructed paved roads and viaducts; they had developed a high degree of art in frescoes, in statuary and bas-reliefs, in decorated pottery, and in medallions. Their gold and silver work was of a high order, they were skilled workers in copper and bronze, and they made exceptionally fine textiles. Some of their statuettes, for example the statuette of the snake goddess, are almost startlingly modern in conception and execution.

They had developed a considerable knowledge of hydraulics. They built fountains, which shows that they knew how to carry water in pipes under pressure. Tapered terra-cotta pipes have been found, with spigots, collars and stop ridges, among the earliest elements of the palace. Water for drinking was apparently obtained also in part from wells, many of which were lined with hard terra-cotta liners, each section being one-third of the periphery, and having a slight socket at the top of each ring to fit the bottom of the next upper ring. Their bath

tubs were remarkably similar to our modern tubs, and perhaps more artistically decorated.

Particularly in the Middle Minoan Period, dated about 1900–1700 B.C., elaborate systems of well-built stone drains were constructed, which carried sewage, roof water and general drainage. The main drain transported these wastes a considerable distance beyond the palace, but we do not know the method of their final disposal.

Each quarter or section of the palace had its own subsidiary drainage system connected to the main drain. These systems had vertical shafts of ample size which acted both as roof drains and as ventilation ducts, the latter in much the same manner as do the soil stacks in our modern houses. The frequent and torrential rains in Crete would result in excellent flushing of the entire drainage system.

Such sanitary arrangements were not particular to the palace at Knossus, but seem to have been an essential part of all Cretan building. A. Mosso, in describing the ruins of the villa of Hagia Triada, makes the following statement:

> One day, after a heavy downpour of rain, I was interested to find that all the drains acted perfectly, and I saw the water flow from sewers through which a man could walk upright. I doubt if there is any other instance of a drainage system acting after 4,000 years.

Perhaps we also may be permitted to doubt whether *our* modern sewerage systems will still be functioning after even one thousand years.

Latrines were provided within the palace, directly connected to vertical chutes or to horizontal drains. Apparently these latrines were flushed after use by emptying a large jar of water into the latrine. The latrine seat was the edge of a wood plank set vertically into recessed slots in the side walls, with the rear wall as a back rest, which was effective but perhaps not quite so comfortable as our modern split-front seats of plastic.

Rubbish was apparently placed in a number of circular walled pits, about 5 meters in diameter, which were probably cleaned out from time to time as necessary.

All in all, the archeological researches on this site yield a picture of a people who had progressed far along the path of comfortable and hygienic living, with a considerable degree of beauty and luxury in their surroundings. And this had been accomplished some four thousand years ago.

All are familiar with the high degree of sanitation achieved by the Romans, but certain rather commonly held errors need correction. For example, the so-called sewers of Rome, of which the Cloaca maxima is the best known, were primarily conduits for the removal of surface drainage (rain water) and underground water. They were not designed as sewers as we understand them today, had few house connections, and were not expected to receive excrement directly. But apparently in ancient Rome excrement and other wastes were thrown into the streets, and thence flushed into the drains in the process of street

cleaning. One of the complaints of Frontinus, the Roman water commissioner of about 100 A.D., was that so much water was feloniously diverted from the aqueducts, for agricultural irrigation outside of Rome, that there was at times insufficient water for cleaning the streets.

Mediaeval and even modern Europeans, so far as sanitation was concerned, were certainly not above the savage level, and even fell below it. In Berlin, the refuse heaps piled up in front of St. Peter's Church until in 1671 a law required every peasant who came to town to remove a load of filth when he returned home.

In 1183, when the Emperor of the Holy Roman Empire held a Diet in the palace of Erfurt, the floor of the main hall broke, precipitating the lords and knights into the cesspool below, where many perished, the Emperor himself barely escaping death.

In Denmark, the cleaning of the latrines was the job of the hangman, who probably did the job very poorly indeed, for in Helsingor in 1583 a Hollander residing there outraged the community by personally cleaning out his latrine after repeated efforts had failed to induce the town officials to have the job done.

Paris in the Middle Ages was the metropolis of Europe and at least superficially the focus of refinement in living. But the streets were foul with filth. Montaigne complained that he found it difficult to rent lodgings where the reek from the streets did not assault his nose. Parisians freely emptied chamber-pots from their windows, only the nimble and the lucky escaped being drenched. The poorer classes defecated indiscriminately wherever most convenient. In 1531 a law required landlords to provide a latrine for every house, but it does not appear to have been well enforced. Toward the time of the French Revolution privies were numerous in Paris, but apparently they were so filthy that even the least fastidious preferred other places. A favorite locality was the terrace of the Tuileries, which eventually became so fouled that the superintendent of the royal grounds installed a latrine, charging an admission fee of two sous.

Enraged at the high price, the public removed their excretory affections to the Royal Palace grounds, forcing the Duc d'Orleans to construct a dozen privies, which fortunately were better patronized. But the Louvre was a mess. People defecated without restraint or attempt at secrecy in the courtyards, on the stairs and balconies, and behind doors, without hindrance by the palace attendants. And if the commonalty were guilty of such gross violations of sanitation and decency, they had excellent examples in high places. On August 8, 1606, an order was given prohibiting any resident of the palace of Saint Germain from committing a nuisance therein. That same day the King's son urinated against the wall of his room.

The disposal of excrement in mediaeval England presented problems which the Englishman of that day tried to solve in various ways, most of them much inferior to the methods developed nearly three thousand years prior in Crete. Little is known of the methods used by the agricultural population; it was probably quite casual. The wealthy

lords built several types for their castles. Where there was running water in the moat, garderobes or latrines were sometimes corbelled out over the moat from the face of the exterior wall, so that the dejecta had a fairly clear drop into the moat. In winter this arrangement was probably cold and drafty, and no doubt the exterior wall was rather well plastered with excrement. In other instances chutes were built into walls, or in separate turrets, and water diverted through the base of the chute. However, this was apt to result in bad odors due to fouling of the sides of the chutes.

Where running water was not available for carrying away the excrement falling into it, pits or cesspools were constructed, frequently of masonry, for storing the excrement received from the floors above via various types of chutes. Chutes were frequently built in the thick walls of chimneys, for warmth, but this undoubtedly added to the odor problem. In other cases the cesspool must have been below the floor, for according to the Coroner's Roll of 1326, Richard the Raker having entered and seated himself, the rotten planks of the floor gave way, and Richard perished most odorously by drowning in the contents of the pit.

In a few cases pipes or channels were built to remove the overflow of the pits, as at Westminster Palace about 1260, but by 1307 this conduit became so blocked with filth that it had to be cleaned out and repaired. However, some of our modern sewers have not lasted forty-seven years, wherefore let us not be censorious.

In mediaeval London the problem was made more difficult because of overcrowding. Public latrines, with running water for the clearance of the excrement, were known in London prior to 1290. Tenements were usually inadequately provided with latrines; for example, in 1579, in Tower Street in the Parish of All Hallows, there were three privies for eighty-five people. Doubtless even in normal times a considerable amount of excrement was simply thrown into the streets and lanes, because of the inadequate and malodorous privies; in abnormal times this condition was aggravated, for in the plague year of 1349 the King ordered city authorities to remove the filth accumulated in the streets and most foully polluting the air of the city, although the city was one-third depleted of its population by the plague.

If the Mediaeval European was a failure in sanitation, his bad example did little to improve the modern European until the very recent present, and then but partially.

In London, the discharge of any water except kitchen slops into the drains was prohibited by law until 1815, and this regulation persisted in Paris until 1880. In London the report of the Health of Towns Commission in 1844 revealed such astonishing amounts of decomposing excrement and organic matter throughout the English cities that the report aroused a strong movement to improve conditions which had long been intolerable. By 1847 it had been made obligatory by law to discharge excrement into the drains, and the cesspits, pail privies and kitchen middens were gradually abolished. But if the Englishmen's long struggle with excrement disposal made rather slow progress in

achieving a satisfactory solution of the problem, it proved highly successful in the production of laughable tales concerning their ineptitudes in this respect, including some hilarious incidents in their novels, for example the inn scene in "Roderick Random." Moliere and other French writers used similar materials, though with greater deftness. Indeed, it would be most surprising if such an ever-present factor in daily life failed to be reflected in the literature of the time.

The Englishmen of the last century finally did succeed in divorcing themselves from immediate juxtaposition with their own excrement and the stench thereof, thereby at long last catching up in part with the Minoans of nearly 4000 years previously, but they for a while merely exchanged one problem for another. As early as 1842 the Poor Law Commissioners advised against the discharge of sewage direct into streams which were used for water supply. London, of course, had simply removed its excrement from accumulation of reeking filth in and about the houses, and transferred the entire mess into the Thames River, within the city limits. Nothing was done about it until 1855, when at the end of a disastrous epidemic of Asiatic cholera (that great blessing of man because it has literally terrified him out of his sanitary apathy and into sanitary improvements), the Nuisance Removal Act was passed, prohibiting gross river pollution. But, in spite of the cholera, for quite a while the interference of gross pollution with the industrial and agricultural uses of water was given more attention than the menace to health. In passing it might be mentioned that London was still to suffer two more great epidemics of cholera, in 1866 and again in 1872, showing how slow human progress was even in the face of the most urgent compulsion.

London, of course, reaped the reward of its bungling attempts to clean up the city by dumping sewage into the river. The years of 1858–59 were the years of the great stink in London. This was vividly described by Dr. William Budd as follows:

> For the first time in the history of man, the sewage of nearly three millions of people had been brought to seethe and ferment under a burning sun, in one vast open cloaca lying in their midst. The result we all know. Stench so foul, we may well believe, had never before ascended to pollute this lower air. Never before, at least, had a stink risen to the height of an historic event. Even ancient fable failed to furnish figures adequate to convey a conception of its thrice Augean foulness. For many weeks, the atmosphere of Parliamentary Committee-rooms was only rendered barely tolerable by the suspension before every window, of blinds saturated with chloride of lime, and by the lavish use of this and other disinfectants. More than once, in spite of similar precautions, the law-courts were suddenly broken up by an insupportable invasion of the noxious vapor. The river steamers lost their accustomed traffic, and travellers, pressed for time, often made a circuit of many miles rather than cross one of the city bridges.
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> For months together, the topic almost monopolized the public prints. Day after day, week after week, the "*Times*" teemed with letters, filled with complaint, prophetic of calamity, or suggesting remedies. Here and there, a more than commonly passionate appeal showed how intensely the evil was felt by those who were condemned to dwell on the Stygian banks. At home and abroad, the state of the chief river was felt to be a national reproach. "India is in revolt, and the Thames stinks," were the two great facts coupled together by a distinguished foreign writer, to mark the climax of a national humiliation.

And this nearly four thousand years after the prehistoric Cretans! How we did progress!

Our English cousins were not slower nor were they less intelligent than the inhabitants of other European countries. Similar conditions could be described "ad nauseum" in various European cities, and also in some of our own (Bubbly Creek in Chicago), but they were unfortunately not described in Budd's pungent prose. And in passing it may be mentioned that in 1940 we ourselves are performing a very fair job in the creation and maintenance of monumental stinks that would do credit to the most barbarous community. For reasons of at least a moderate delicacy, I refrain from naming names.

Urban man today still unnecessarily pollutes streams, bathing beaches, bays and estuaries, without benefit of the excuse of ignorance which was available to his ancestors.

Sewage works associations, engineering societies and the public health associations are doing good work in enlarging the technical knowledge needed to solve our sanitary problems, but whether they can do much to jolt the sanitary conscience of the average man into really adequate sanitary action still seems to be dubious. We appear at present to be possessed of more technical knowledge than we are permitted to apply, due to the conflict between the immediate dollar of sanitation expenditure versus (to the average man) rather intangible future comforts and benefits.

If our progress today is so much less than what we know is possible, let us not be disheartened. Even though in four thousand years we have accomplished relatively little in sanitation, remember that after all that is but a small sector of time in man's history. He has existed in substantially his present type for at least 150,000 years, during which time he has not abolished or appreciably diminished war, or famine, or pestilence, nor murder, avarice, greed, intolerance, nor economic disasters, nor does it appear to be even probable that he will ever do so, and probably our great-grandchildren's remote descendants will still be struggling with the problem of disposing of their excrement.