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DURING THE EVOLUTION OF THE U.S., the water, air, and land resources available to our forefathers were immeasurably vast. So vast, in fact, that they appeared to be of infinite proportions, and their use and consumption were taken for granted. However, as the population grew, it became clear that these resources, particularly a clean and abundant water supply, were not infinite and, in some cases, not even available. A case in point is the water supply problem that confronted New York almost from its inception. A visitor to New York in 1748 declared, “There is no good water to be met within the town itself” [Koepfel, 1994]. In 1774, the city authorized a water system, but it was not until 1841, when the Croton Aqueduct was completed, that New Yorkers could experience cool, clean water for

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FIGURE II.1 Thomas Crapper invented many improvements to indoor flush toilets.

drinking, bath, and fire fighting. They could even dream about the luxury of indoor plumbing. Four years prior to 1841, a son was born to a humble British family in the Yorkshire town of Thorne, who was to make a major contribution regarding the handling of human waste products. The child's name was Thomas Crapper. Figure II.1 shows an advertisement for Thomas Crapper & Company. Crapper was an entrepreneurial sanitary engineer and the inventor of many improvements to indoor flush toilets [Rayburn, 1989].

By 1840, there were only 83 public water supplies in the U.S., but the demand was growing, and by 1870, there were 243 [Fuhrman, 1984]. With these burgeoning public water supplies came the need to consider the disposal of the "used" water. In Europe during the Middle Ages, people simply threw their excreta out the window, as the woodcut in Fig. II.2 demonstrates [Rayburn, 1989]. Word has it that some sport was involved in this process involving the passersby in the street below [Alleman, 1994].

Recognition at about this time that water supplies, disease, and disposal of human waste were interconnected led to the requirement that used water and excrement be discharged to sewers. In 1850, a member of the Sanitary Commission of Massachusetts, Lemuel Shattuck, reported the relationship between water supply, sewers, and health. He recommended the formation of a State Board of Health, which would include a civil engineer, a chemist or physicist, two physicians, and two others. During this time, a French chemist by the name of Louis Pasteur was initiating research that was to found the field of bacteriology



FIGURE II.2 “Sanitation” in the Middle Ages. (From an old woodcut.)

and connect bacteria with disease. In addition, Pasteur was to demonstrate the benefits of utilizing bacteria in industrial processes. The use of bacteria to stabilize municipal waste was coming to the fore.

In 1887, the Massachusetts State Board of Health established an experiment station at Lawrence for investigating water treatment and water pollution control. This station was similar to others that had been established in England and Germany and was the forerunner of eight others established throughout the U.S. Topics investigated were primary wastewater treatment, secondary treatment via trickling filters, and activated sludge.

As the population of the U.S. continues to grow, greater demand is being placed on our natural resources. What were once adequate treatment and disposal methods now require far greater levels of cleanup before waste is discharged to water courses, the atmosphere, or onto the land. In essence, water, air, and land are no longer free economic goods, as has been assumed for so many years. The cost of using water, air, and land resources is the cleanup cost prior to their return to the environment. This section will deal with those broader topics in water treatment, wastewater treatment, air pollution, landfills, and incineration.

References

- Alleman, J. E. 1994. Personal communication.
- Fuhrman, R. E. 1984. History of water pollution control. *J. Water Pollut. Control Fed.* 56(4):306–313.
- Koepfel, G. 1994. A struggle for water. *Invent. Technol.* 9(3).
- Rayburn, W. 1989. *Flushed with Pride*. Pavilion, London.