

Cooperative Sanitation

Managing Streets and Gutters in Late Medieval England and Scandinavia

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Managing uncomplicated technology can be complicated. In the late medieval city, the relationship between man and environment was negotiated and managed through seemingly simple technologies: latrines and open refuse pits served as the waste-disposal facilities; urban roads were at best cobblestone streets with surface gutters to facilitate drainage. Such basic systems were prone to failure if individual actions countered their effectiveness—for example, by throwing waste in the street gutters or by failing to maintain street pavement. In order for the technologies to work as intended, cities required complex management of individual behavior in addition to the basic provision of pits and cobbled streets. Although city councils oversaw sanitation in the medieval city, they made individuals directly responsible for the smooth operation of the systems. This distribution of power both reinforced the governance role of the medieval city council over municipal sanitation and gave individuals a place in the ownership of the system. The effectiveness of medieval sanitation was contingent upon *both* physical maintenance of the technology and cooperation from residents.

This article investigates the workings of late medieval sanitation technologies on the ground level. It attempts to define the roles of city corporations and individuals in the areas of street maintenance and waste management between the years 1350 and 1550. I am particularly interested in how solutions to sanitation issues were constructed as a relationship be-

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tween the city government and urban inhabitants. For this reason, I will not be addressing royal decrees about sanitation measures, although one could certainly examine changes in the delegation of sanitation responsibility from royal to local officials.¹ In addition, I am focusing on household waste, not business-related craft waste that would require additional discussion about the relationship between city governments and business interests.² The main questions raised here are: How involved were citizens in sanitation provisions? What kind of services, such as paving, street cleaning, and waste pickup, did the city provide? How did involvement by inhabitants and government officials affect sanitation technologies? These questions focus on the ways in which medieval societies crafted social relations to create functional technological sanitation systems.

Previous studies have tackled the question of responsibility for late medieval sanitation as a legal issue. For example, studies of London and an investigation into the laws of the Italian city-states have documented the legal foundations of medieval sanitation.³ Yet historians have said little

1. The English royal government, for example, was involved in highway maintenance through pavage grants. The king's patent rolls record numerous cases in which the English crown granted towns or individuals the right to collect tolls on goods coming into urban areas or via particular routes in order to pay for highway maintenance. Often, these grants were specifically for the paving of rural highways between market centers. King Richard II also issued a royal statute in 1388 requiring city governments to clean up dung and other garbage disposed of improperly within their urban areas: 12 Richard II c13, *The Statutes of the Realm*, vol. 2 (London, 1963 [1816]), 59–60. Miriam Carole Davis has compared the interests in sanitation of the British crown and city governments in both the pre- and post-plague periods; see Davis, "The English Medieval Urban Environment: Learned Views and Popular Practice" (Ph.D. diss., University of California, Santa Barbara, 1994).

2. There was, however, significant medieval legislation applicable to craft activities, particularly the work of dyers, tanners, and butchers. For a good discussion of London's attempts to control butchery waste, see Ernest L. Sabine, "Butchering in Mediaeval London," *Speculum* 8 (July 1933): 335–53. A short general discussion of Italian medieval legislation targeting craft waste can be found in Ronald E. Zupko and Robert A. Laures, *Straws in the Wind: Medieval Urban Environmental Law—the Case of Northern Italy* (Boulder, Colo., 1996).

3. Sanitary conditions as a legal issue received some attention at the beginning of the twentieth century; see T. P. Cooper, "The Mediaeval Highways, Streets, Open Ditches, and Sanitary Conditions of the City of York," *Yorkshire Archaeological Journal* 22 (1912): 270–86; Lynn Thorndike, "Sanitation, Baths, and Street-Cleaning in the Middle Ages and Renaissance," *Speculum* 3 (1928): 192–203; Ernest L. Sabine, "Latrines and Cesspools of Medieval London," *Speculum* 9 (1934): 303–21; and Ernest L. Sabine, "City Cleaning in Medieval London," *Speculum* 12 (1937): 19–43. The most extensive modern examination of medieval sanitation legislative activities is in Zupko and Laures, *Straws in the Wind*. They conclude that although town elites attempted to provide a "respectable quality of life" for their citizens, their efforts were "incomplete, sporadic, and sometimes misguided," like throwing straws in the wind (p. 111). For sanitary conditions in medieval France, see André Guilleme, *The Age of Water: The Urban Environment in the North of France, A.D. 300–1800* (College Station, Tex., 1988), and Jean-Pierre Leguay, *La Pollution au Moyen Âge* (Paris, 1999).

about the *practical* aspects of city sanitation efforts. The previous studies thus overlook the physicality of sanitation.⁴ Sanitation is, in fact, a very practical, material matter. This article thus incorporates both written and physical evidence to reveal *how* legislated issues worked (or failed to work) in practice.

Working with medieval sources to explore urban sanitation has some inherent limitations. Although the availability of written sources increases after 1350, the records are still spotty and provide only brief glimpses into medieval life in each city. Therefore this article combines the primary records and archaeological evidence from several different urban centers in England and Scandinavia.

The written records focus on Coventry, Norwich, and York, England, and Stockholm, Sweden, because of the survival of relatively complete city council meeting minutes from the fifteenth and sixteenth centuries.⁵ In

4. There are a few exceptions. Roberta Magnusson employs physical evidence alongside the textual in her discussion of medieval water-supply systems in *Water Technology in the Middle Ages: Cities, Monasteries, and Waterworks after the Roman Empire* (Baltimore, 2001). She includes a brief discussion of waste-disposal practices and street cleaning in the late medieval city as well (see pp. 155–62). Derek Keene, “Rubbish in Medieval Towns,” in *Environmental Archeology in the Urban Context*, ed. A. R. Hall and H. K. Kenward (London, 1982), 26–30, deals with rubbish disposal in the documentary sources as it applies to urban archaeology. Keene’s chapter, which only includes evidence from early Winchester and London, focuses on what the archaeologist is likely to encounter rather than on pragmatic sanitation measures. Cooper’s 1912 article appeared in an archaeological journal, but he includes little archaeological evidence to support his sweeping claim that “the thoroughfares and byways of towns and cities were loathsome and deep with offensive matter, and were a constant danger to health and life” (p. 271). His most extended discussion is on the physical remains of gutter systems, but even this shows only that gutters eventually drained into the river (which would be expected for any kind of rain-drainage system!), not that they were filled with rubbish.

5. These late medieval city council records have for the most part been transcribed from the original medieval manuscripts and published. For Coventry, see *The Coventry Leet Book, or Mayor’s Register, Containing the Records of the City Court Leet or View of Frankpledge, A.D. 1420–1555, with Divers Other Matters*, 4 pts., trans. and ed. Mary Dormer Harris (London, 1913), which contains the semi-annual council proceedings. For York, several volumes recorded complaints brought before the council and legislation passed in the city. These have been published in several different sets: *York Memorandum Book lettered A/Y in the Guildhall Muniment Room, Part I and II*, ed. Maud Sellers (Durham, UK, 1912, 1915); *York Memorandum Book (B/Y)*, ed. Joyce W. Percy (Gateshead, UK, 1973); *The York House Books, 1461–1490*, 2 vols., ed. Lorraine C. Attreed (Wolfboro Falls, N.H., 1991); and *York Civic Records*, vols. 2–5, ed. Angelo Raine (York, 1940, 1942, 1945–46). *The York Bridgemasters’ Accounts*, vol. 2, trans. Philip M. Stell (York, 2002), records financial transactions related to York’s bridges. For Norwich, extracts from various city registers have been printed in *The Records of the City of Norwich*, 2 vols., ed. William Hudson and J. C. Tingey (Norwich, 1906, 1910). Some of Norwich’s court records have been printed as *Leet Jurisdiction in the City of Norwich during the XIIIth and XIVth Centuries*, vol. 5, ed. William Hudson (London, 1892). Stockholm’s council proceedings have been published in a series of volumes titled *Stockholms stadsböcker från äldre tid* (Stockholm, 1917–39). In this article, citations of these primary

addition to the completeness of the city records, these locations have several things in common: they were all provincial market centers; their populations ranged from around 5,000 to 12,000 for most of the period under study; the city government was dominated by a mayor and council; and unlike their continental counterparts, they did not use older Roman sanitation infrastructure. London, with its population of 40,000 to 50,000 in 1400, was the anomaly in the northernmost reaches of Europe and is thus excluded from this study. By using urban areas of a smaller size rather than the metropolis of London, this article aims to illuminate the sanitation technology management schemes in more typical urban centers.⁶

The medieval governments of these cities developed into powerful civic authorities during the two hundred years from 1350 to 1550—the so-called late medieval period.⁷ Stephen Rigby has noted that the fifteenth century in England was “a period of literate civic self-awareness.” The city government actively monitored trade activities, hosted religious festivals highlighting civic authority and pride, and collected taxes from residents. The number of surviving court books and records dramatically increases after 1350 because of the growing interest in documenting civic statutes that confirmed the city as a legal entity superseding the individual elites who participated in the government. The detailed organization of civic government differed from city to city, but all had a ruling council with a presiding mayor that exercised both judicial and legislative authority. As a judicial body, the medieval council heard misdemeanor presentments, levied fines, and received capital pledges for minor offenses. In the legislative arena, the council issued ordinances founded on bills presented to the mayor by any individual or group who wished to voice a grievance or amend common practice. Aldermen represented each section of the city on the council. In both its judicial and legislative roles, the council tackled the environmental issues of the late medieval town in conjunction with residents.⁸

sources are given with the volume or part (if appropriate) and the page number in the printed version of the text.

6. For a discussion of London’s medieval sanitation, see Sabine’s three articles (“Butchering in Mediaeval London,” “Latrines and Cesspools of Medieval London,” and “City Cleaning in Medieval London”), as well as Caroline M. Barron, *London in the Later Middle Ages: Government and People, 1200–1500* (Oxford, 2004). Both Sabine and Barron investigate sanitation through legal records of complaints, including the London House Books and Assize of Nuisance records.

7. I refer to the urban centers in this study as “cities.” Although they were not as populous as many continental cities such as Paris, Cologne, Florence, and Rome, I have opted to call them cities because they were the largest urban centers in their respective regions other than London, and because the medieval governmental elites consistently refer to their own urban area as a “city” in the written records (often as “Citee” or “Cite” in English texts; *staden* in Swedish texts; and *civitas* in Latin passages).

8. Stephen Rigby, “Urban ‘Oligarchy’ in Late Medieval England,” in *Towns and Townspeople in the Fifteenth Century*, ed. John A. F. Thomson (Gloucester, 1988), 62; Mary Dormer Harris, “Introduction,” in *The Coventry Leet Book*, pt. 4, xvii–xxvii. City councils orig-

In addition to the documentary evidence from these cities, this article includes physical evidence unearthed in archaeological digs to illustrate the nature of medieval sanitation. This archaeological evidence derives mainly from Norwegian, Swedish, and Danish locations, with some support from York and Norwich excavations. Scandinavian archaeologists have extensively analyzed urban archaeological investigations for changes in sanitary infrastructures, including roads, gutters, and latrines, making their work particularly relevant to this study. Because of the physical nature of sanitation, the archaeological evidence is just as important as its written counterpart for appreciating how medieval sanitation systems worked.⁹

In order to illustrate how the effectiveness of medieval sanitation depended on the legal, cultural, and material involvement of both city governments and residents, this article examines the issue of street maintenance and cleanliness in detail. The first section sketches the street technology in use during the period and its function as a sanitation system. The next two sections demonstrate how medieval city councils attempted to regulate their citizens' behavior, both by requiring them to maintain street paving and by prohibiting waste disposal in the streets. Archaeological evidence and written court cases help to reveal just how effective these measures were. The final section of this article argues that city governments also responded to the technological simplicity of waste-disposal methods by establishing city-run services, which acted to counter uncontrollable individual misdeeds. The ensuing discussion makes clear how the sanitation technologies of the Middle Ages required significant oversight, control, and personal attention to make them effective.

Streets and Paving in the Middle Ages

Although it may be imagined that medieval streets were muddy tracks through town, by the late medieval period paved streets were not uncommon.¹⁰ Numerous archaeological finds in the urban areas of England and

inated before 1350 but written records are sparse before that time, so little can be said about their character. The early 1400s witnessed a formalization of duties and roles of council officers.

9. See for example Anders Andrén, "I städernas undre värld," in *Medeltiden och arkeologin: Festskrift till Erik Cinthio*, ed. Anders Andrén et al. (Lund, 1986), 259–70; Hannah Dahlerup Koch, "Middelalderens gader," in *KUML 200: Årbog for Jysk Arkæologisk Selskab*, ed. Jesper Laursen (Aarhus, 2000), 284–86; Lena Beronius Jörpeland, "Den grå vardagen—standing och renhållning i den medeltida staden," *Bebyggelsehistorisk tidskrift* 42 (2001): 59–74; Bård Gram Økland and Knut Høiaas, *Bare boss? Håndtering av avfall i Bergen gjennom 1000 år* (Bergen, 2000); and the chapters in Manfred Gläser, ed., *Lübecker Kolloquium zur Stadtarchäologie im Hanseraum IV: Die Infrastruktur* (Lübeck, 2004).

10. David Nicholas (*The Later Medieval City, 1300–1500* [London, 1997]) notes that most cities began paving major streets during the thirteenth century and that cobblestone was common by the fourteenth. Based on evidence from France and Italy, he also

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Scandinavia (only a small number of which will be included in this study) attest to this. Considering the economic importance of commerce in urban centers, it should come as no surprise that cities needed roads that were passable at all times of the year and in all weather conditions. In addition to their role in trade, however, streets were also an integral part of the medieval sanitation system because street gutters facilitated urban drainage of both rainwater and liquid wastes. Paving aided the drainage function of the streets. If city residents disposed of solid wastes such as dung on the streets, the gutters would become clogged and fail to serve their drainage purpose. Therefore, city governments found it imperative to regulate how streets were used. The scale of investments (both in money and in public authority) in paving streets indicates the power of medieval councils to shape the urban environment and their willingness to act on conceptions of the common good in both the economic and public health arenas.

Archaeological evidence shows that medieval street paving came in three basic varieties: wooden planking, gravel surfaces, and laid stone. Wooden planking appears to have been preferred as the earliest type of paving near harbors in Scandinavia. It was most appropriate in wharf areas because it could be installed on piles driven into sand instead of requiring a flat surface to rest upon, as with stone pavement. In Bergen's wharf district, part of the planked surface of a 3.6-meter-wide public thoroughfare in Bugården has been dated to immediately after the city fire of 1332. In another Bergen tenement area, Engelgården, the tenement passage from the 1300s has survived in almost the full length of the site. It was paved with transverse boards and had a drain down the center, which appeared to have been covered separately by wooden planks. Archaeological finds of wooden planked streets in Oslo also date to the thirteenth century.¹¹

Gravel surfaces—also called metalled surfaces—sometimes replaced wooden surfaces in Scandinavia; in England, they are often the earliest surviving type of pavement. For example, in Bergen's Søstergården, a new surface of sand and gravel covered the traditional log surface of the Old Church Road after a fire in 1476. The earliest archaeological evidence for metalling of streets in Norwich has been dated to the thirteenth century in the Friary precinct; in this case, the first surface was gravel, which was later replaced by flint rubble.¹²

observes that the maintenance of roads, bridges, canals, and conduits became major line-item expenses in later medieval city budgets (p. 334).

11. Asbjørn Herteig, *The Buildings at Bryggen: Their Topographical and Chronological Development* (Oslo, 1990), 58, 75; Petter B. Molaug, "The Infrastructure of Oslo from the 11th to 17th Centuries," in *Lübecker Kolloquium zur Stadtarchäologie im Hanseraum IV*, 507.

12. Herteig, 98; Brian Ayers, "The Infrastructure of Norwich from the 12th to 17th Centuries," in *Lübecker Kolloquium zur Stadtarchäologie im Hanseraum IV*, 37. Cowgate's thirteenth- and fourteenth-century surface was also gravel.

The most durable, and expensive, type of street paving was a regular stone surface. This type of urban street became increasingly common in the fourteenth through the sixteenth centuries. Although regular stone surfaces required more maintenance, they also wore better under heavy traffic. On the Bugården thoroughfare, which had been planked in wood sometime around 1332, the surface was repaved in stone by 1400. The excavated stone-paved surface extended 7 to 8 meters, along with a drain covering a distance of approximately 11 meters. The stone paving consisted of flat, untrimmed stones laid next to one another to create a relatively continuous surface. In Ribe, Denmark, stone-paved streets with a gutter in the middle typically succeeded the wooden ones during the fourteenth century. Uppsala, Sweden, appears to have had cobblestone streets from about 1170 and never to have used wooden planking. Almost all of its urban streets were cobbled by the fourteenth century. In addition, crushed limestone pavement dates back to about 1500. The physical evidence indicates that by the late medieval period, regular stone pavement covered many streets within urban centers.¹³

Cobblestone surfaces appeared on both large and small streets. In *A History of Technology and Invention*, Maurice Daumas states that because paving with large stones was expensive, it was “adopted only for streets that carried heavy traffic.” Daumas, however, only used evidence from Paris—a large royal capital—so his conclusions may not be widely applicable. In York, even small streets were paved: a twelfth-century lane was surfaced with cobblestones, and alleyways dated to around 1300 were paved with cobblestones and/or limestone rubble. Uppsala’s paved streets included both small and large passageways as well. The widespread existence of paved streets demonstrates that the urban environment was much more controlled and maintained than many historians have assumed. The paving of small streets suggests that city residents were as concerned about residential transportation and public health as they were about the economic benefits of market roads.¹⁴

Streets served not only as transportation routes, but also as urban environmental systems through their function as drainage conduits. Street gutters managed the flow of rainwater, keeping streets passable and making the city habitable. Unlike modern configurations with gutters on either side of the street, medieval streets typically had one gutter running down the mid-

13. Herteig, 58; Jakob Kieffer-Olsen, “The Infrastructure of Ribe,” in *Lübecker Kolloquium zur Stadtarchäologie im Hanseraum IV*, 545; Johan Anund, “Interaction, Convention and Regulation Infrastructures in Medieval Uppsala,” in *Lübecker Kolloquium zur Stadtarchäologie im Hanseraum IV*, 440–41.

14. Maurice Daumas, *A History of Technology and Invention: Progress through the Ages*, vol. 2, trans. Eileen B. Hennessy (New York, 1969), 508; Richard A. Hall, “York’s Medieval Infrastructure,” in *Lübecker Kolloquium zur Stadtarchäologie im Hanseraum IV*, 80; Anund, 440–41.

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dle, as in the case of the pavement on York's Ouse Bridge, which was constructed with "the chanell set in the myddward of the same." In Bergen, an excavated stone-paved street was equipped with a wide gutter constructed with slender, roughly square stakes approximately 1.5 meters long laid in a V-shape in the middle of the street. Gravel fill stabilized the sides of the gutter. Paved streets with gutters were also common in fourteenth-century Ribe. The ubiquity of streets outfitted with gutters indicates that inhabitants of the late medieval city recognized and valued the streets' function within the urban drainage system.¹⁵

Residents could, however, use street gutters improperly as waste-disposal receptacles. A list of street obstructers in the Norwich records provides some examples of this behavior: John Lymmes, a dyer, constantly laid muck and paste in the king's highway under the wall of St. Martin's churchyard; William Gerard left a dead horse in the roadway; and Giles Alberd made a muck heap along with a sawing pit in the street. The Coventry city council noted that individuals purposefully swept waste into the street in order "to convey the dunge or Mucke therof into the seid River." Paved streets and associated gutters provided transportation and drainage benefits only as long as they were kept in good condition and free of waste.¹⁶

Maintaining Streets through Divided Responsibility

The late medieval street-paving and guttering techniques described above were not particularly complicated technologies to implement. They did, however, require maintenance to prevent the pavement from rapidly disintegrating, as well as some level of coordination of repair efforts. The written records indicate that city councils actively planned and maintained streets in order to sanitize the urban space. So how did the councils adequately maintain paved streets?

Cities typically shifted the burden of street maintenance to their inhabitants. The councils mandated that residents and shop owners maintain the pavement directly in front of their homes and establishments. In council records, these orders typically come with a calendar deadline and a fine to be levied for noncompliance. In 1423, for example, Coventry's council ordered all tenement-holders to repair the pavement in front of their houses before the next council meeting in six months. The fine for violators was set at three shillings, four pence. In 1495, the same council explicitly granted the common sergeant permission to repair any pavements not properly maintained and to charge the responsible party for the full cost of the repairs, in addition to a fine. In 1550, the York council required all inhabi-

15. *York Civic Records* (n. 5 above), vol. 2, 171; Herteig, 34; Kieffer-Olsen, 545.

16. *Leet Jurisdiction in the City of Norwich* (n. 5 above), 75–76; *The Coventry Leet Book* (n. 5 above), pt. 3, 720–21.

tants to repave the surface in front of their doors as often as necessary to sufficiently maintain the street. Residents were typically responsible for the pavement up to the middle gutter: Norwich's council specified that every owner of every dwelling had to level the street with sand or stone pavement up to its middle, and Coventry's required each owner to pave from the door front to the center gutter. The responsibility to pave the street in front of each door was set up similarly to a property tax, in that property owners and tenants had to contribute financially to the maintenance of the streets.¹⁷

Placing pavement maintenance in the hands of residents had disadvantages. In 1559, the Norwich council enacted "An Actte for the Pavyng of Stretes." In the act, the council first acknowledged the long-standing tradition of paving the city streets that had been "a great ease and helthefull commodyte" and beautified the urban area. Because Norwich was a major market and busy commercial urban center, it would be easy to understand why paved streets would be a valuable commodity. Well-maintained streets bolstered the city's image as a good place to work and live. The act noted that recently, however, "the great gredynes and obstynacy" of men had caused the streets to decay, and the pavement was broken to the "discommodyte and annoyaunce of the neybour and travaylors." The maintenance of pavement was completely lacking in places where previously it had been properly kept up. This reveals one of the problems of assigning citizenry the task of paving. The council responded by requiring that all persons having a house or land adjoining any common street in the city repair the pavement in front of their property using stone, as was "the use and custome of the cittie," within three months of the act's proclamation. For every yard of street not properly paved with stones, the responsible party would pay a fine of six pence. Thus the only response the Norwich council had to the poor street maintenance habits of its citizenry was to reissue a mandate for individuals to pave their street sections or else be subject to fines. We do not know the efficacy of this reissued mandate.¹⁸

17. *The Coventry Leet Book*, pt. 1, 58; pt. 3, 568–69; *York Civic Records*, vol. 5, 30; *The Records of the City of Norwich* (n. 5 above), vol. 2, 96–98; *The Coventry Leet Book*, pt. 3, 804. Coventry also issued orders to repair pavement in particular parts of town (pt. 1, 233; pt. 3, 607, 712). The records indicate that residents typically bore the financial burden of paving. Some English cities also had the right to collect "pavage," which were taxes on incoming goods to pay for street paving, but the records do not indicate that this was a significant source of money for paving in the cities under consideration in this article. The king granted only Coventry the right to collect pavage for seven years in 1305, and granted York the same for five years in 1329; see *Calendar of the Patent Rolls Preserved in the Public Record Office, Edward I*, vol. 4, 1301–07 (London, 1898), 361, and *Calendar of the Patent Rolls Preserved in the Public Record Office, Edward III*, vol. 1, 1327–30 (London, 1891), 457.

18. *The Records of the City of Norwich*, vol. 2, 133–34. The act even included a provision for those unable to pay their fine within fourteen days: to have their fine arbitrated

Through the documentary evidence above, we see that city councils demanded street maintenance. But how were these mandates put into practice? In the standard encyclopedic reference, *A History of Technology*, the authors state that “though in theory road-maintenance was an obligation of the landowners the obligation was little regarded.” Physical evidence from several Scandinavian cities contradicts this claim, however. Scandinavian archaeological finds suggest that urban householders took seriously their responsibility for maintaining road surfaces. Many of Oslo’s wooden planked streets show differences in the pattern of the planking corresponding to different house plots. In some places, the planks are laid differently on either side of the centerline of the street, visually demonstrating the shifting responsibility of street maintenance both laterally down the street and across its centerline from one tenement to the next. These differences illustrate that individual owners really did maintain their own pavement sections. In Uppsala, fifteenth-century streets show that not only was the central line of the street marked, but also that the boundaries of plots were extended to the middle line of the street with the aid of larger stones; thus, every householder was allocated a clearly marked rectangle that he was obliged to keep paved and clean (fig. 1). This clear physical delineation of householder responsibility attests to the importance of property owners’ duty to maintain the pavement: each householder knew the area for which he was responsible, and lax individuals were easier to identify.¹⁹

Even though the cities demanded the individual participation of residents in maintaining the streets, they did not necessarily think that every individual would physically install new pavement. Instead, the Coventry council expected residents to pay for the services of professional pavers. In 1442, it ordered that the mayor hire street pavers, whose wages would be paid by collecting money from all free tenement-holders. An entry from 1474 recognized “paver” as an occupation and required that pavers install only quality pavement: “euery payver that paveth within the Cite that he made goode & sufficient payvng, vppon the peyn to pave hit newe at his owne charge.”²⁰ In York, professional pavers regularly maintained pavement on the Foss and Ouse bridges. The bridgemaster paid for these services out of the bridge tax revenues. In addition, the city accounts noted other places in town where the city paid for paving services, including streets and marketplaces. The professionalization of paving services indi-

by a group of five or six men chosen by the mayor to hear the specific details of the violator’s financial situation.

19. Charles Singer et al., *A History of Technology*, vol. 2 (Oxford, 1957), 524; Molaug (n. 11 above), 507; Gun Westholm, “Sanitary Infrastructure in Mediaeval Visby—Waste Disposal and Town Planning,” in *Lübecker Kolloquium zur Stadtarchäologie im Hanseräum IV* (n. 9 above), 499; Anund (n. 13 above), 442.

20. *The Coventry Leet Book*, pt. 1, 199; pt. 2, 389. The “paviors” of London were organized as a city company at about the same time, in 1479 (Singer et al., 533).



FIG. 1 Medieval road paving using larger stones to demarcate individual residents' responsibility for pavement upkeep and street cleanliness in Uppsala, Sweden. (Reproduced courtesy of the National Heritage Board of Sweden.)

cates both the high demand for adequate paving and the willingness on the part of individuals and city governments to pay for these services. It also suggests some level of systemization of paving activities: by employing professionals, a certain quality level could be guaranteed and variations in paving surfaces minimized.²¹

The relatively straightforward technology employed in street paving allowed it to become both a civic and individual responsibility in the medieval city. The city councils ordered residents to maintain the street directly in front of their property. As we have seen, some cities even employed physical markers to delineate street-maintenance responsibility. Governments took an active interest in the condition of their street pavement and fined those citizens who did not comply with their mandates. Both the law and the physical layout of the streets enabled city councils to make individuals responsible for ordinary maintenance activities.

21. *The York Bridgemasters' Accounts* (n. 5 above), 63, 439, 98, 110, respectively. Other locations where York's government provided paving included Walmegate Bar, the end of Colliergate, and the end of Saint Saviour's way, Hosiergate and Nesgate (p. 439), and the marketplace "called the Pavement" (*York Civic Records* [n. 5 above], vol. 2, 171).

Managing Waste in the Streets through Simple Technology and Control

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In addition to their role in the drainage of liquid waste, streets and gutters constituted a convenient solid waste–disposal venue for some householders. The late medieval city generated large concentrations of waste, including horse manure, slaughtered animal entrails, latrine contents, and construction rubble. This waste could be thrown into gutters, and ostensibly the rainwater would wash it away. This solved individual citizens' problems regarding the disposal of their waste, but at the same time it caused larger communal problems of impassable streets and river blockages. Thus the simple technologies of streets and gutters required city council control and residential participation.

First, the councils issued prohibitions against using streets for general waste disposal. They wanted to maintain more sanitary streets by avoiding the putrefaction of accumulated waste in streets and rivers. Thus, as early as 1421, Coventry prohibited the raking and sweeping of dung into the streets during times of rain. In 1444, a specific ordinance was passed that “no manure to be swept into the gutter or 4d. fine.” The council clearly intended these mandates to keep the street gutters free from blockage and prevent waste from running off into the city ditches and river, as they stated explicitly that sweeping the gutters to clear filth away while it was raining would “pester the Ryver with fylthe & muck.” The council recognized that individuals purposefully swept waste into the street in order for it to be conveyed into the river. Its statements prove that the streets and river were overtly understood as a holistic environmental system: what happened upstream in the streets had a direct impact on the downstream river. The government therefore acted to carefully manage both parts of the system by controlling individual behavior.²²

Second, city laws required that householders and shop owners clean the streets in front of their doors, typically on a weekly basis. These activities made inhabitants of the city directly responsible for the condition of the streets. Because each householder was responsible for cleaning in front of his own property, any passersby would know immediately who was not complying with cleaning orders. Street-cleaning activities are well documented for both the English and Scandinavian cities. In Coventry, the 1421 Mayor's Proclamation required every man to clean the street in front of his place on every Saturday or else pay a twelve-pence fine, with no exceptions. In York in 1484, the council ordered ward officers to inspect the urban and suburban streets to ensure that they were “clenely keptid and wekely sweped.” The

22. *The Coventry Leet Book* (n. 5 above), pt. 1, 29–30; pt. 1, 208; pt. 3, 804; pt. 3, 720–21. The Norwich council also recognized the interconnectedness of the streets and river as an environmental system, noting that filth entered the river by way of “cockeys, gutters and other meanes”; see *The Records of the City of Norwich*, vol. 2, 115–16.

council reiterated this requirement in 1550, adding that inhabitants were responsible for cleaning and sweeping any part of a street in front of their dwelling twice each week. In 1552, the council specified that the cleaning was to take place every Saturday and Tuesday. A 1548 Swedish law ordered citizens to clean the streets every Saturday and to maintain good stone pavement on them. Through these relatively straightforward laws, the councils demanded that urban residents take responsibility for street cleanliness on a regular basis.²³

Street-cleaning programs could become more complicated though. Stockholm implemented a complex, biweekly, neighborhood program in 1557: first, the householder living farthest up the hill from the sea began by sweeping the street and rinsing it with one barrel of water. Then, as the runoff reached the next neighbor down, he rinsed the street in front of his house with another barrel of water. This proceeded successively down toward the harbor so that by the end, all of the accumulated dirt and filth was drained into the harbor. Anyone failing to comply with this biweekly cleaning was fined one mark for the first two times, three marks for the third, and then the fine would double for each successive violation. The fine was split between the reporter of the violation (one-third) and the city (two-thirds). Such a specific plan of action reveals that the council was keenly interested in city cleanliness, and that the responsibilities associated therewith had to be divided among the residents in order to achieve it.²⁴

The question still remains as to how vigorously the cities enforced their cleaning requirements and bans on dumping waste in streets. Although enforcement records are not nearly as numerous as legislative commands, a few court records survive for the cities under consideration here. We have evidence that Coventry's council enforced its ban on sweeping manure into the gutter: in 1540, the plumber Walter Lacy paid a fine of four pence "for castyng dunge and filthe into the gutter." Coventry also fined a carter twelve pence for laying dung in the highway outside of New Gate in 1540. Stockholm's enforcement of waste-disposal laws was recorded alongside legislative activities in their council meeting records; several times, its council collected a twelve-mark fine for waste thrown into the streets or markets. The Norwich court rolls included citations for dumping cartloads of muck in the river or for laying muck in the streets. These fines indicate that the courts did at least occasionally enforce urban bans on improper waste disposal.²⁵

23. *The Coventry Leet Book*, pt. 1, 30; *The York House Books* (n. 5 above), vol. 1, 353–54; *York Civic Records*, vol. 5, 30, 82; *Privilegier, resolutioner och förordningar för Sveriges städer*, vol. 2, ed. Ernst Nygren (Stockholm, 1932), 568.

24. *Privilegier, resolutioner och förordningar för Sveriges städer*, vol. 2, 352.

25. Levi Fox, "Some New Evidence of Leet Activity in Coventry, 1540–41," *English Historical Review* 61 (1946): 238–39; *Stockholms Stads Tänkeböcker 1474–1483 samt Burspråk*, ed. Emil Hildebrand (Stockholm, 1917), 220; *Stockholms Stads Tänkeböcker 1483–1492*, ed. Gottfrid Carlsson (Stockholm, 1921), 133; *Stockholms Stads Tänkeböcker*

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Archaeological evidence also addresses the question of whether the streets were common trash dumping sites. Derek Keene argues that the streets of Winchester, England, were clearly used for waste disposal, because archaeologists found thick deposits of muddy soil containing animal bones and pottery between the paved surfaces. In his assessment, “in wet weather most streets and lanes must have been at least ankle-deep in refuse.”²⁶ It is possible, however, that the layers found in archaeological excavations did not accumulate over extended periods of time, but were instead intentionally placed as waste fill. Waste was commonly used before 1350 as leveling material and fill to reclaim land from swamps and bays. Even in the late medieval period, waste may at times have been used as fill. The Nottingham city expenses recorded in detail the costs of paving the city’s streets, and one entry recorded paying for “carying of ramell to the same lane to highten it with.”²⁷ In this case, “ramell,” meaning rubbish or rubble, was clearly placed on the old street surface as part of the leveling activities prior to laying the new paving on top of it. The possibility that waste layers in the archaeological record were intentional fill should not be overlooked.

Other physical evidence indicates, in fact, that there was not much urban waste accumulation in the late medieval period. By then, cultural layers (i.e., waste-containing deposits) become rarer in the archaeological record in the Scandinavian cities. In Lund, Sweden, an archaeological investigation revealed five meters of cultural layers dating from the year 1000 to the present. Four meters of the accumulation (80 percent of the total) can be dated from 1000 to 1300, and only about a third of a meter from 1300 to 1500. Anders Andréén interprets the thinner cultural layers during the late medieval period as signaling less waste disposal in the city and/or more extensive cleaning than in earlier medieval eras. In Roskilde, streets accumulated cultural layers consisting of animal dung, human feces, food waste, workshop waste, and building material before 1400, but there was much less accumulation after that date. Hannah Koch surmises that stone paving and the growing urban population and density created the need to regularly clean the streets. She also notes that little new paving was required after the end of the fifteenth century because waste was no longer accumulating on the

1492–1500, ed. Joh. Ax. Almquist (Stockholm, 1930), 324; and *Leet Jurisdiction in the City of Norwich* (n. 5 above), 65, 89. In addition, the Norwich leet records include several fines for improper disposal of craft waste.

26. Keene, “Rubbish in Medieval Towns” (n. 4 above), 28, and Derek Keene, *Survey of Medieval Winchester*, vol. 1, pt. 1 (Oxford, 1985), 53. Keene says that there are regular presentments in the Winchester city court for throwing dung and rubbish into the streets, but he also indicates that the problem shows up most often in the marketplaces, a cemetery, and in one particular street. Therefore his generalized assessment of the street conditions in Winchester might be an overstatement.

27. “Particulars of the Chamberlains’ Expenditure, 1485–86,” in *Records of the Borough of Nottingham, being a series of extracts from the archives of the corporation of Nottingham*, vol. 3 (Nottingham, 1885), 260.

streets. The cultural-layer accumulation in Bergen also decreased during the late medieval period; it was significantly reduced in the Bryggen area after 1413, and at the same time there was less accumulation in the northern part of Øvrestretet. Scandinavian archaeologists have identified similar trends in Trondheim, Oslo, Ålborg, Kolding, and Århus; this suggests that less waste was deposited within the urban core and that more was taken outside the city walls for disposal. This trend toward less waste disposal within urban spaces indicates that city residents were not indiscriminately dumping their waste into the streets and their neighbors' property.²⁸

The archaeological evidence and written records of fines indicate that city officials and urban residents maintained relatively clean streets. Making residents responsible for cleaning the area in front of their property preserved the overall condition of the streets. During the late medieval period some waste in the streets may have been a daily reality, just as littering is today, but streets covered with several inches of refuse do not appear to have been a regular part of urban life.

Practical Cleaning Measures

City governments relied on residents to do their part in cleaning the streets, but they may have found it difficult to keep waste from reaching the streets without providing convenient alternatives for the inhabitants. Governments therefore turned to public sanitation services, including the provision of public facilities and city-paid workers such as dung carters and street cleaners.

One way to control human waste disposal was to provide permanent public facilities. Beginning in 1367, the York council financially and administratively supported a public latrine house on a large bridge over the Ouse River. Medieval bridges such as Ouse's were large stone structures that supported shops and residences on the spans themselves, much like the Ponte Vecchio in Florence still does. Ernest Sabine found that London's public latrines served both transient businessmen as well as residents without access to private latrines. City officials expected residents to use the public facilities rather than dumping their excrement and urine in the streets, as is evident in complaints brought against those who behaved otherwise. In 1400, the Ouse Bridge's financial records attest to the city paying thirteen shillings, eight pence for its yearly maintenance. The city continued to finan-

28. Andrén (n. 9 above), 260–64; Koch (n. 9 above), 269–71, 293; Bård Gram Økland, "Det ureine avfallet? Ein arkeologisk analyse av avfallshandtering i Bergen 1150–1700" (master's thesis, University of Bergen, 1998), 101. The deposition of household waste "was clearly reduced from the 14th century" in Århus, Denmark, according to Hans Skov, "The Infrastructure in Århus between 900 and 1600 AD," in *Lübecker Kolloquium zur Stadtarchäologie im Hanseraum IV* (n. 9 above), 560. See also Jörpeland (n. 9 above), 61–63.

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cially support the latrine throughout the fifteenth century. Several entries in the records state that the city paid six shillings, four pence annually for oil to light the latrines, which indicates that the facilities were regularly patronized, even at night. The city also paid two shillings annually to a widow “for keeping cleyn the place of Owsbrige callyd the pyssing howes.” The case of York’s public latrines highlights the long-term commitment made by its council to manage the human waste within its city walls.²⁹

To combat waste disposal in the streets, medieval city governments identified allowable disposal locations and even provided city services to remove waste from the urban area. Coventry’s council required that “no man carry no dung out of his house nor out of his stables into the street, but if they have carts ready to carry it away.” Dunghills and waste pits generally sprang up around the perimeters of towns, outside of the heavy populated sections. Some city councils went to great pains to name permissible disposal sites. By 1427, Coventry had five designated waste-disposal locations: a dunghill outside the city limits, beyond Greyfriar Gate; a pit in the Little Park Street Gate; a muckhill near the cross beyond New Gate; at Derne Gate; and a pit at Poddycroft. All of these locations were just beyond a city gate.³⁰ In Stockholm, a 1482 proclamation listed all the places where waste disposal was forbidden and required individuals to “take it where the marks stand above the hills.” Seven years later, the council agreed that places both east and west of the city should be identified for the regular disposal of waste from the urban area.³¹ The creation of these designated waste-disposal spaces helped order the city.

All three English cities in this study provided city-run waste-cart serv-

29. Barbara Wilson and Frances Mee, “*The Fairest Arch in England*”: *Old Ouse Bridge, York, and Its Buildings—the Pictorial Evidence* (York, 2002), 54; *The York Bridgemasters’ Accounts* (n. 5 above), 122, 208, 257; *York Civic Records* (n. 5 above), vol. 4, 122. The years 1445, 1454, 1459, 1462, 1464, 1468, and 1488 in the *Bridgemasters’ Accounts* all contain entries of the annual payment for the light in the latrine house. Although the expense is not noted in all years, the city’s payment would appear to have been “the custom,” as noted in the entry for 1459. Sabine, in “*Latrines and Cesspools of Medieval London*,” counted references to at least thirteen public latrines in the fourteenth-century records.

30. *The Coventry Leet Book* (n. 5 above), pt. 1, 29–30, 43, 113. At one point, the Coventry council ordered the chamberlain to do a better job of monitoring waste disposal near the city gates, especially at Greyfriar Gate. If any waste was dumped at the gates, the chamberlain had to clean it up at his own cost (pt. 2, 425). It is difficult to distinguish between the management of human and animal waste in the city records, because both are referred to as “dung” and “muck.” Animal manure was likely a more substantial problem in the urban setting than human excrement, which was confined to waste pits and could be emptied on some kind of regular basis, whereas cattle and horse manure was generated in large quantities and typically piled in stables, pens, and on the street.

31. *Stockholms Stads Tänkeböcker 1474–1483* (n. 25 above), 489, forbade waste disposal in the stream, in markets, on a hill by the castle, on the Greyfriar’s bridge, and at the harbor docks; see also *Stockholms Stads Tänkeböcker 1483–1492* (n. 25 above), 328.

ices. In York, the council mandated that a dung cart be placed in every ward. In Norwich, the council provided two weekly muck carts to serve nine parishes. The council instructed residents to pile up their “ffilthe and vile mater” into round heaps placed so that the waste would not enter the ditches before the carter could carry it away. In Coventry, as early as 1420, a waste carter collected one pence from every resident and shop on a quarterly basis for weekly street cleansing and waste-removal services. In 1452, the constable of each ward was responsible for ensuring that the weekly cart service was provided. Anyone refusing to pay their one-pence tax would be referred to the ward’s alderman and required to pay double. The cart came by to pick up waste, particularly dung, on Saturday. On Sunday afternoon and Monday, the common serjeant and town crier would walk through town to ensure compliance and fine any violators two pence. This provision of weekly waste-removal services reveals a commitment by the city officials to maintain clean streets and city order; residents were required to pay a tax to cover these services, and city officials were responsible for providing them.³²

In Scandinavia, barrels and waste bins appear in several cities beginning in the 1200s. Putting waste into barrels at the point of generation allowed it to be removed easily. Residents placed barrels in the ground or at the corners of houses or in courtyards. In both cases, it would appear that householders removed the barrel contents for final disposal offsite, and the archaeological evidence that remains is from the final time the barrel was filled. This use of barrels for household waste makes sense in conjunction with the carting services, for barrels would facilitate waste disposal by passing collection carts.³³

Archaeological excavations show that latrine construction during the late medieval period also allowed waste to be removed and taken offsite. Rows of small latrines appear in the narrow lanes between buildings and warehouses in Bergen’s commercial area of Bryggen. Latrines in alleys were constructed as a box with removable walls so that owners could remove the waste when full. The trend during the fourteenth century was to discontinue the use of latrines within houses and to prefer latrines set up in overhanging galleries or as separate, stand-alone structures, which permitted easier access for the regular removal of their contents. This change demonstrates a growing preference for removing human excrement from dwelling areas. Excavations in Norwich also indicate that waste-disposal patterns shifted during the thirteenth century from in-place disposal to temporary storage onsite, followed by offsite disposal. Lined cesspools datable to the late fourteenth and mid-fifteenth centuries reflect “the growing practice of using temporary storage ‘bins’ on site for rubbish which was later removed as night soil.” Evidence from York indicates a similar shift by the beginning

32. *York Civic Records*, vol. 2, 165; *The Records of the City of Norwich* (n. 5 above), vol. 2, 110; *The Coventry Leet Book*, pt. 1, 21; pt. 2, 273, 552–53; pt. 3, 586–87.

33. Jörpeland, 67, 70.

of the fourteenth century, from unlined pits that remained filled to stone-lined cesspools that could be cleaned out. This means that citizens regularly disposed of latrine waste outside of their living spaces.³⁴

The carting services collected organic matter for use as manure. Excrement, both human and animal, as well as putrescent household matter thus became a commodity instead of merely waste. The city of York ordered that dung should be removed from the wards so that “husbands of the contre” could make use of it. Until 1550, it appears that people in York paid for this commodity: in that year, the city’s mayor issued a statement declaring that any person could now take dung free of charge from the city’s multiple dunghills for use as manure. Coventry’s council forbade the disposal of stones, construction material, or other filth at the Greyfriar waste heap and specified that only dung or muck could be deposited there so that local farmers could use it to manure their fields. Archaeological evidence of the paucity of dung accumulation in the late medieval city supports the written evidence that dung was regularly removed from inhabited areas. Because of the primitive technologies available, such as the use of night soil and animal dung as fertilizer, waste disposal had to become a highly social activity in the medieval city, with responsibility for sanitation divided between the government and citizenry.³⁵

In addition to carting services, cities often employed regular street cleaners—again indicating a commitment by city governments to the maintenance of their urban environments. The Norwich council appointed two persons in each ward to clean the streets. In Coventry, a door tax of one pence per quarter paid for street-cleaning services. The Stockholm council records have several entries dealing with paid street cleaners. In 1481, the city appointed Pedher Hansson to clean up all areas in front of the bridge and on the shore, paying him with an annual salary as well as clothing. The next year, the council authorized a one-time payment of twelve marks to a carrier to “carry off the uncleanness which they have laid illegally.” In 1486, the council made another one-time appointment of carriers to re-

34. Økland and Høiaas (n. 9 above), 7; Økland (n. 28 above), 56; Malcolm Atkin and D. H. Evans, “Excavations in Northern Conesford, in and around the Cathedral Close,” in *Excavations in Norwich 1971–1978, Part III*, ed. Malcolm Atkin and D. H. Evans (Norwich, 2002); East Anglian Archaeology Report No. 100, 12, 31; P. V. Addyman, “The Archaeology of Public Health,” *World Archaeology* 21 (1989): 257–58. Archaeological evidence from Copenhagen also reveals a shift to brick-lined cesspits, but this occurs in the sixteenth century according to Johan Møhlenfeldt Jensen, “The Infrastructure of Copenhagen,” in *Lübecker Kolloquium zur Stadtarchäologie im Hanseraum IV* (n. 9 above), 536. Økland also points out that human excrement deposits are limited to the Øvrestret area of Bergen after circa 1330, and all human waste disappears from the Bryggen area after 1400, indicating that the waste was not haphazardly deposited around town or on the streets in the late medieval period (p. 93).

35. *York Civic Records* (n. 5 above), vol. 2, 165; vol. 5, 48; *The Coventry Leet Book*, pt. 2, 447; pt. 3, 804; Andrén (n. 9 above), 264.

move filth that had accumulated in pits in front of the cross in the residential area of Södermalm. And in 1494, a man named Engelbreth was offered six marks to cart away the city's waste. These services demanded both financial support from citizens and management by the city council.³⁶

The records demonstrate that keeping streets free from waste was a high priority for city councils, and that this responsibility was divided between individual inhabitants and the city government. Restrictions on behavior helped alleviate improper waste disposal, but the government also turned to regular street cleaners and waste-disposal services to assist in keeping the city clean. Wardens were directly responsible for inspecting streets and rooting out individuals who were not participating in the cleaning process. The relatively simple technologies of waste handling and disposal required an active commitment on the part of both city government and citizens to make it work.

Conclusion: The Uncomplicated Becomes Complicated

The uncomplicated technologies of streets, gutters, waste bins, and latrines required complicated management strategies in the late medieval city. It would be easy to regard the physical, technological artifacts of a street—a gutter, an open waste pit, or a basic latrine—and assume that street maintenance and waste handling were as simple, straightforward, and ineffective as these technologies superficially appear. Indeed, this has led many scholars to believe that the system must have been ineffective.³⁷ But this approach overlooks the complex social relationships that actually made the system work.

The various city records and archaeological finds concerning street maintenance and waste handling reveal that sanitation in the medieval city required the cooperation of city government and individuals. City councils diligently implemented both legal restrictions on citizens' behavior and new city services to create a sanitary city. Far from being a minor concern, the effort to keep the streets and cities clean and in passable order appears

36. *The Records of the City of Norwich*, vol. 1, 288; *The Coventry Leet Book* (n. 5 above), pt. 2, 273; *Stockholms Stads Tånkeböcker 1474–1483*, 319, 333; *Stockholms Stads Tånkeböcker 1483–1492*, 131; *Stockholms Stads Tånkeböcker 1492–1500* (n. 25 above), 153.

37. See Zupko and Laures, *Straws in the Wind* (n. 2 above), and Keene, "Rubbish in Medieval Towns" (n. 4 above). Scholars of modern sanitation history have adopted the same view. Martin V. Melosi, for example, gives little thought to the possible effectiveness of the medieval city's waste-handling methods, which he characterizes as "primitive"; see Melosi, *Garbage in the Cities: Refuse, Reform, and the Environment*, rev. ed. (Pittsburgh, 2005), 5–6. Even his discussion of early American sanitation makes the same assumption that technological complexity and systematic city services were required for sanitation efficacy; see Martin V. Melosi, *The Sanitary City: Urban Infrastructure in America from Colonial Times to the Present* (Baltimore, 2000), chap. 1.

regularly in the records. Physical evidence and court records reveal the way these laws worked and illustrate how individuals in large part cooperated with city governments to make their urban homes clean. The councils invested time and money to clean up their urban spaces and required that those living within them do the same.

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Sharing the responsibility for sanitation was obviously not without challenges. Dependence on citizens' participation meant that sanitation measures were not entirely under the control of the councils. This aspect of the medieval system has thus been criticized as ineffective. For example, T. P. Cooper argued that "Corporations delegated the duty of keeping the streets clean to the citizens at large, but as they failed to perform this necessary duty, the streets remained dirty and unkept"; Constance Classen, David Howes, and Anthony Synnott stated that medieval waste laws "were often ineffective because they placed too much of the burden for its disposal on individual householders."³⁸ This critique has generally been based on records indicating that legislation had to be reissued. However, although there are multiple complaints in the records, we must remember that these are spaced out over extended periods of time. For example, Coventry's council issued bans on sweeping waste into streets and gutters nine times between 1421 and 1552.³⁹ During this 130-year span, it should not be surprising that there were some violators of sanitary regulations, and that legislation would need to be restated. We should not assume that the problem was commonplace, but rather that it fell outside the norm and was deemed unacceptable. As we have seen, archaeological evidence indicates that there was little waste accumulation on late medieval streets, and the survival of paving patterns corresponding to individual plot boundaries indicates that residents actively participated in city upkeep. In addition, the councils went beyond legislation and hired the services of pavers and carters to overcome some of the shortcomings of residential behavior.

The medieval technological and social sanitation systems made individuals responsible for and aware of the consequences of their actions on the urban environment. Through city councils' mandates for involvement on the ground level, from physical labor to direct taxation, medieval residents could not have failed to understand their role in shaping the city space. They had a financial incentive to comply with council mandates, and they directly observed the benefits of waste management. The distribution of power between the city government and citizens both reinforced the role of the medieval city council to promote and coordinate sanitation controls and made individuals responsible for the day-to-day operation of the sys-

38. Cooper (n. 3 above), 271; Constance Classen, David Howes, and Anthony Synnott, *Aroma: The Cultural History of Smell* (London, 1994), 57.

39. *The Coventry Leet Book*, pt. 1, 23, 208, 217, 234; pt. 2, 306, 418; pt. 3, 720–21, 775, 804.

tem. Uncomplicated medieval sanitation technologies required complicated social structures to make them work.

This conclusion has implications for the broader scholarly quest to understand how technologies shape social relations, and vice versa. It cannot be assumed that a mundane, seemingly uncomplicated technology functions on its own. Even the simplest waste-handling methods such as open-pit disposal and spreading manure on fields required the development of political and social structures to ensure that the waste was collected within a reasonable timeframe and removed to an appropriate location. Entirely new governmental roles were created to manage basic waste disposal; individual residents participated by paying taxes toward these services and by piling up their waste outside on the appointed pickup day.

The technological artifact is not the entire technological story. By situating these urban technologies within their larger social frameworks, we can see how such basic infrastructure was turned into an effective and cooperative sanitation system.