

THE PRIVATE SIDE OF PUBLIC HEALTH: SANITARY SCIENCE, DOMESTIC HYGIENE, AND THE GERM THEORY, 1870–1900*

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Disease and grim death stalk through our fine dwelling houses, disease and grim death of our own making. . . . When we are soundly asleep, cradled in fancied security, the impalpable subtle enemy, malaria, arises from the outlets of the very utensils [water closets and sinks] introduced for the preservation of our health, for the prolongation of our lives, fanning us into deeper slumbers, like the wings of the vampire.

—Leopold Brandeis, 1873–74¹

 Warnings about the health dangers posed by domestic plumbing were commonplace in the popular American press of the 1870s and the 1880s. So pervasive were such dire cautions about “sewer gas,” as malaria or impure air was more commonly known, that the “good people of New England feared it perhaps more than they did the Evil One,” according to Charles V. Chapin, a prominent public health authority. Hardly had the alarm over sewer gas subsided before the earnest readers of advice literature were bombarded by information about another “insidious foe that stealthily enters our homes and destroys our health,” namely the germ. With the rapid popularization of the germ theory in the late 1870s and the 1880s, literate Americans learned that “the higher life is . . . everywhere inter-penetrated . . . by the lower life,” in the words of one microscopist, and that their

* Earlier versions of the paper were presented at the sixty-second annual meeting of the American Association for the History of Medicine, 28 April 1989; at the Francis C. Wood Institute for the History of Medicine and the University of Illinois at Champaign-Urbana in April 1989; and at the history department colloquium, State University of New York at Stony Brook, in March 1990. I thank the audiences at those sessions for their helpful comments. I would also like to thank the following people for their helpful comments on this article: Joan Jacobs Brumberg, Gretchen Condran, Janet Golden, Christopher Sellers, Janet Tighe, and the anonymous reviewers for the *Bulletin of the History of Medicine*. The staffs of the Historical Collections of the College of Physicians of Philadelphia, Philadelphia, Pa., the National Library of Medicine, History of Medicine Division, Bethesda, Md., and the Hagley Museum and Library, Wilmington, Del., were exceptionally helpful in tracking down materials for me. Research for the article was conducted during my tenure as a Rockefeller fellow at the Wood Institute of the College of Physicians of Philadelphia during 1988–89.

¹ Leopold Brandeis, “Defective house drainage,” *Sanitarian*, 1873–74, 1: 447.

damp cellars, dusty carpets, and dank water closets were domestic breeding grounds for these invisible agents of deadly disease.²

From sewer gas to germs, late nineteenth-century Americans became alert to a host of new dangers lurking in the home. Their anxieties reflected the hard work of several generations of health reformers, loosely aligned under the banner of sanitary science, who claimed to have scientific proof that damp cellars, poor ventilation, dirty carpets, and untrapped soil pipes caused the spread of typhoid, diphtheria, scarlet fever, and other infectious diseases.³ Initially focused on the unsanitary conditions of tenements and other dwellings of the poor, the campaign to improve domestic hygiene was broadened to include the abodes of the wealthy as well. For late nineteenth-century domestic sanitarians, as they might be called, the home became an important vector of disease among all classes of the citizenry.⁴

The new concern with preventing what were often collectively referred to as "house diseases" inspired a spate of popular literature, including advice books, magazines, newspaper articles, and health department circulars, designed to instruct homeowners and housewives in the principles of domestic hygiene. At a time when municipal public health services were still very primitive, the public was urged to take individual measures, such as improving household ventilation and plumbing, boiling and filtering drinking water, and isolating the sick within the household, to protect their loved ones from debility and death. Even as learned doctors continued to debate the dangers posed by sewer gas and germs, health reformers relentlessly promoted a simpler, less scrupulous version of sanitary science that emphasized the efficacy of individual action against disease.

² Charles V. Chapin, *Papers of Charles V. Chapin, M.D.*, ed. Clarence L. Scamman (New York: Commonwealth Fund; London: Oxford University Press, 1934), p. 50; *Information Regarding the Germicide and Its Protective Influence* (Philadelphia: Pennsylvania Germicide Co., 1884); L. S. Beale, quoted in W. D. Foster, *A History of Medical Bacteriology and Immunology* (London: Heinemann, 1970), p. 16.

³ In this article, I use the term *infectious* to denote diseases that spread from person to person, including the category of contagious diseases. As the most cursory reading of the literature shows, the distinction between the terms *infectious* and *contagious* was very confused in the nineteenth century. The English sanitarian George Wilson observed in 1880, "'infection' and 'contagion' are now used as synonymous terms, or, at all events, are used indiscriminately, and are intended to convey the same meaning." George Wilson, *Health and Healthy Homes: A Guide to Domestic Hygiene*, ed. Joseph G. Richardson (Philadelphia: Presley Blakiston, 1880), p. 117. Most scientific discussions limited the term *contagious* to diseases that spread by direct, person-to-person contact, and used the term *infectious* to denote both contagious diseases, and diseases that could be spread by corrupted matter in the air or water. I have tried to stick to their usage.

⁴ I use the term *domestic sanitarians* to denote reformers who in the 1870s and the 1880s emphasized popular education and domestic hygiene as important goals of the public health movement. Concern about domestic hygiene was a relatively late development in the sanitarian movement. While they were concerned about the sanitary condition of urban slums, where squalid homes bred epidemics, the pioneer generation of English sanitarians, including Edwin Chadwick and Thomas Southwood Smith, were not much interested in popular education or domestic sanitary reform; their first concern was state medicine and broad-gauge environmental reform. I suspect that later, when the progress of state medicine seemed stymied by political and popular apathy, sanitarians began to invest more energy in finding private solutions to public health problems. This does *not* mean that they gave up the ideals of state medicine but rather that they believed in voluntary reform as a necessary intermediary step to acquire the political backing from voters to widen state power over health matters. By my definition, the writings of Benjamin Richardson and George Wilson in England and George Waring and Henry Hartshorne in the United States are good examples of domestic sanitarian argument.

For a variety of reasons, the sanitarian message gained an early and wide hearing among the urban middle and upper classes. Affluent Americans were a peculiarly house-proud people, for whom owning a home, furnishing it tastefully, and running it efficiently were badges of respectability. From the 1820s onward, they consumed reams of advice literature aimed at making their dwellings more beautiful, more functional, and more morally uplifting. An intense attachment to the home was part of a "cult of domesticity" that targeted middle-class women and invested family life, particularly child rearing, with enormous moral and social significance. Compounding this significance was the peculiar health consciousness of nineteenth-century Americans, who avidly pursued new fads in diet, dress, and exercise. In an era of high geographic and social mobility, habits of personal hygiene became less a matter of following tradition and more a reflection of individual "enlightenment" and self-discipline.⁵

Given the middle class's commitment to improving their homes and their health, the steadily rising rates of both epidemic and endemic infectious diseases in antebellum American cities naturally caused great concern. In a culture where declining family size and heightened individualism made the emotional aspects of family life increasingly intense, the impact of disease on the city-born young, one-third to one-half of whom died before their tenth birthday, was particularly ghastly. To protect their families, affluent Americans, especially mothers, had good reason to pay heed to sanitarian reformers who linked rising rates of disease to individual sanitary failings.⁶

Under the sanitarians' tutelage, health-conscious Americans developed a heightened awareness of domestic sources of infection, and adopted var-

⁵The literature on the middle-class American family and its insatiable "manual mania," as Kathryn Kish Sklar terms it in her introduction to Catharine E. Beecher, *A Treatise on Domestic Economy* (1841; New York: Schocken Books, 1977), p. v, is extensive. Some useful works on the history of homelife and the family are Sylvia D. Hoffert, *Private Matters: American Attitudes toward Childbearing and Infant Nurture in the Urban North, 1800–1860* (Urbana: University of Illinois Press, 1989); Mary P. Ryan, *Cradle of the Middle Class: The Family in Oneida County, New York, 1790–1865* (Cambridge and New York: Cambridge University Press, 1981); and Kathryn K. Sklar, *Catharine Beecher: A Study in American Domesticity* (New Haven, Connecticut: Yale University Press, 1973). For the American obsession with staying healthy, see Susan E. Cayleff, *Wash and Be Healed: The Water-Cure Movement and Women's Health* (Philadelphia: Temple University Press, 1987); Anita Clair Fellman and Michael Fellman, *Making Sense of Self: Medical Advice Literature in Late Nineteenth Century America* (Philadelphia: University of Pennsylvania Press, 1981); Harvey Green, *Fit for America: Health, Fitness, Sport, and American Society* (New York: Pantheon Books, 1986); Martha H. Verbrugge, *Able-Bodied Womanhood: Personal Health and Social Change in Nineteenth-Century Boston* (New York: Oxford University Press, 1988); and James Whorton, *Crusaders for Fitness: The History of American Health Reformers* (Princeton, New Jersey: Princeton University Press, 1982). The special appeal of health reform to women is explored in Regina Morantz, "Nineteenth Century Health Reform and Women: A Program of Self-Help," in *Medicine without Doctors: Home Health Care in American History*, ed. Guenter B. Risse, Ronald L. Numbers, and Judith W. Leavitt (New York: Science History Publications, 1977), pp. 73–93; and *idem*, "Making women modern: middle-class women and health reform in nineteenth-century America," *J. Soc. Hist.*, 1977, 10: 490–507.

⁶On the decline in mortality rates from infectious diseases, see Gretchen A. Condran and Rose A. Cheney, "Mortality trends in Philadelphia: age- and cause-specific death rates 1870–1930," *Demography*, 1982, 19: 97–123; Gretchen Condran, Henry Williams, and Rose Cheney, "The decline in mortality in Philadelphia from 1870 to 1930: the role of municipal services," *Pennsylvania Mag. Hist. Biog.*, 1984, 108: 153–77; and Frederick L. Hoffman, "American Mortality Progress during the Last Half Century," in *A Half-Century of Public Health*, ed. Mazyck P. Ravenal (1921; New York: Arno Press, 1970), pp. 94–117.

ious protective rituals—ranging from leaving windows open at night to boiling water and using chemical disinfectants—to ward off disease. As we now make efforts to evade carcinogens such as asbestos and radon, so they performed home tests of air and water, drank bottled water, purchased patent devices to filter out disease-causing agents, and sought a healthy lifestyle that would build their own, and their children's, resistance to infection. While both sexes had duties to perform in protecting the sanitary state of the home, the burden of daily watchfulness fell more heavily on wives and mothers.⁷ The brisk sale of "sanitary goods," from flush toilets to patent water filters and chemical disinfectants, attests to the growing anxieties of the Victorian *mater-* and *paterfamilias*, anxieties that were sometimes preyed upon by unscrupulous commercial interests.

This fascinating episode in the history of changing popular attitudes and beliefs about infectious disease has been curiously neglected by historians. While nineteenth-century scholars are very familiar with other aspects of the sanitarians' work, such as their persistent campaigns to found city and state health departments, pass stringent health legislation, and build modern sewer and water purification facilities, their equally strenuous efforts to revolutionize what I term the "private side" of public health have gone virtually unacknowledged and unexplored by both social and medical historians.

To be sure, social historians have freely invoked the sanitarians' formulation "Dirt equals disease" to explain the increasing rigor of both bathing and housecleaning. However, social historians have tended to treat the expressed concern about disease prevention as a rationalization for some other, more genuine, objective such as reinforcing gender roles, class differences, or ethnic prejudices. As Norbert Elias wrote in 1939 in his classic work on civilization and manners, "the primary impulse" for changes in personal hygiene "does not come from rational understanding of the causes of illness, but . . . from changes in the way people live together, in the structure of society." In other words, this school of analysis assumes that the decision to install water closets and use disinfectants in the home had more to do with upholding the conventions of social class and of gender roles than it did with the desire to evade disease.⁸

⁷ This gender-linked burden led middle-class women to play an active role in municipal sanitary reform, as Suellen M. Hoy shows in "Municipal Housekeeping: The Role of Women in Improving Urban Sanitation Practices, 1880–1917," in *Pollution and Reform in American Cities, 1870–1930*, ed. Martin V. Melosi (Austin: University of Texas Press, 1980), pp. 173–98.

⁸ Norbert Elias, *The Civilizing Process: The History of Manners*, trans. of 1939 German ed. (Oxford: Basil Blackwell, 1978), p. 159. A more recent cultural analysis in the same spirit is Georges Vigarello, *Concepts of Cleanliness: Changing Attitudes in France since the Middle Ages*, trans. Jean Birrell (Cambridge and New York: Cambridge University Press, 1988). On bathing and personal cleanliness, see Richard L. Bushman and Claudia L. Bushman, "The early history of cleanliness in America," *J. Amer. Hist.*, 1988, 74: 1213–38; and Jacqueline Wilkie, "Submerged sensuality: technology and the perception of bathing," *J. Soc. Hist.*, 1986, 19: 649–64. On changing architectural and housekeeping standards in the nineteenth century, see Ruth Schwartz Cowan, *More Work for Mother: The Ironies of Household Technology from the Open Hearth to the Microwave* (New York: Basic Books, 1983); Faye E. Dudden, *Serving Women: Household Service in Nineteenth Century America* (Middletown, Connecticut: Wesleyan University Press, 1983); and Gwendolyn Wright, *Moralism and the Model*

Unfortunately, historians of medicine and public health, who might be expected to accord more importance to changing scientific concepts of disease, have shied away from the topic as well, for reasons that are deeply rooted in their own historiographical traditions. The conventional portrait of the sanitarians emphasizes their devotion to municipal works on a grand scale rather than their passionate commitment to popular education and voluntary reform. The nineteenth-century public health movement is usually seen in terms of the drive to expand the state's power to regulate the larger urban environment; supposedly it was not until the rise of the bacteriologically based "new public health" of the early twentieth century that popular education and personal hygiene became imperatives of the movement.⁹ The crusade against "house diseases" (that is, diseases spread by improper domestic practices) does not fit conventional intellectual divisions into historical periods either; since Lloyd G. Stevenson's widely read article "Science down the Drain" (1955) first portrayed the sanitarians as hostile to experimental medicine and the germ theory, medical historians have tended to assume that the 1880s marked a deep intellectual divide between scientific world views. Before that decade, the miasma theory, which equated infection with atmospheric impurity, supposedly prevailed, whereas afterwards all right-minded physicians accepted the germ theory of specific contagion. Thus the persistence from 1870 to 1920 of sanitarian beliefs and practices about the importance of domestic hygiene appears as a curious anomaly, rather than a vital, integral aspect of the public health program.¹⁰

Historians also have a natural tendency to focus on the evolution of scientific measures that actually "worked," as defined by current standards. From the standpoint of modern knowledge, nineteenth-century concerns about deadly sewer gas and pathogenic carpets seem hardly to warrant the same attention as large-scale water purification or smallpox vaccination pro-

Home: Domestic Architecture and Cultural Conflict in Chicago, 1873-1913 (Chicago, Illinois: University of Chicago Press, 1980).

⁹What I think of as the "narrowing" thesis is usually associated with Barbara G. Rosenkrantz's *Public Health and the State: Changing Views in Massachusetts, 1842-1936* (Cambridge, Massachusetts: Harvard University Press, 1972). Rosenkrantz argues that the conception of *state* medicine became increasingly biomedical, as public health officials tried to put their profession on a solid scientific basis. However, she does not argue that the whole public health movement abandoned its interest in the broader social and economic determinants of disease (see esp. pp. 177-82). Elizabeth Fee makes a similar point in *Disease and Discovery: A History of the Johns Hopkins School of Hygiene and Public Health, 1916-1939* (Baltimore: Johns Hopkins University Press, 1987). An excellent history of the public health movement in one city, which manages to be very sensitive to social and cultural context, is Judith Walzer Leavitt's *The Healthiest City: Milwaukee and the Politics of Health Reform* (Princeton, New Jersey: Princeton University Press, 1982). Also John Duffy's valuable new survey, *The Sanitarians: A History of American Public Health* (Urbana: University of Illinois Press, 1990), shows much more interest in popular education than older volumes on the subject.

¹⁰Lloyd G. Stevenson, "Science down the drain: on the hostility of certain sanitarians to animal experimentation, bacteriology, and immunology," *Bull. Hist. Med.*, 1955, 29: 1-26. See also James H. Cassedy, "The flamboyant Colonel Waring: an anticontagionist holds the American stage in the age of Pasteur and Koch," *ibid.*, 1962, 36: 163-76, which anticipates many of my arguments in this paper; and Charles E. Rosenberg, "Florence Nightingale on Contagion: The Hospital as Moral Universe," in *Healing and History: Essays for George Rosen*, ed. Charles E. Rosenberg (New York: Science History Publications, 1979), pp. 116-36.

grams. Thomas McKeown's contention that improvements in nutrition and general living standards contributed most to the decline of mortality from infectious disease perhaps reinforced the inclination to dismiss domestic hygiene practices as negligible factors in the overall decline of mortality. No doubt the fact that much of the popular hygiene message was directed at women contributed to its perception as a quaint but unimportant topic.¹¹

In this article, I will argue that, to the contrary, the late nineteenth-century campaign to reform households, as well as the behavior of individuals within them, is deserving of much more attention from both social and medical historians than it has customarily received. The drive to prevent infectious disease certainly became entangled with nineteenth-century social prejudices, yet it possessed an impetus of its own, born of both high death rates and changing scientific knowledge of disease, that has not been sufficiently acknowledged or explored by social historians. Without denying the complexity of the cultural processes involved, I believe that changing scientific concepts of disease had more to do with transforming personal and domestic hygiene than is usually assumed. In fact, the sanitarian crusade against "house diseases" represents one of the earliest instances in which new scientific information—in this case, information about the origins and prevention of disease—led to widespread changes in popular behavior through the medium of mass education.

Far from being a tangential concern of the public health movement, I will argue that the educational work and voluntary reform of the 1870s and 1880s laid the groundwork for the better-known public works of succeeding decades. Adding the "private side" to the conventional narrative about the late nineteenth-century public health movement will make for a more balanced record of its emphases and achievements. It also highlights the growing influence of medical science on popular culture: an influence that preceded and helped to make possible the increasing prestige of medicine in Progressive Era America.¹²

By analyzing the campaign against house diseases, I hope to correct the facile opposition of "miasma versus germ theory" by showing that, at least at the level of popular science, the assimilation of sanitarian theories of infection and contagion paved the way for the rapid acceptance of the germ theory. By pathologizing the home in the decades from 1860 to 1880, the domestic sanitarians created a framework, in terms of both ideas and methods of popular education, for the relatively rapid dissemination of the belief that microorganisms were the agents of human disease. Domestic hygiene thus provides a fascinating glimpse of a more general process of

¹¹ Thomas McKeown, *The Modern Rise of Population* (New York: Academic Press, 1976).

¹² I believe that the popular acceptance of sanitary science gave the physician a new confidence in dealing with patients and their families, which helped to improve the profession's popular image in the 1880s and the 1890s, before the benefits of the newer, experimental medicine were much evident. This is an argument that I plan to make in the book I am now writing.

intellectual change whereby new information about microorganisms was understood and acted upon in the framework of older ideas and behaviors. The study of popular preventive measures underscores the growing tension between elite scientific debates about disease, which often ridiculed simplistic concepts such as sewer gas and germs, and the version of scientific "truth" offered to the public by public health authorities, who downplayed dissension for the sake of justifying a clear and presumably comforting course of action.¹³

Finally, I will speculate on some interesting demographic implications of the history of changes in domestic hygiene. Demographers have recently become interested in the role of personal hygiene as a factor in lowering mortality rates from infectious diseases. Studies in Third World countries have shown that the mother's level of education and mastery of hygienic food preparation contribute significantly to the success of programs to reduce infant mortality. This modern finding has led to a reconsideration of the demographic puzzle posed by the late nineteenth-century "mortality transition": that is, why did a significant decline in mortality from infectious diseases take place *before* there was a large-scale purification of the supplies of water and milk? Historical demographers are now investigating whether changes in personal hygiene may have played a more important role in the nineteenth-century mortality transition than has been previously assumed. By studying the changing theory and practice of domestic hygiene, historians can make a useful contribution to current demographical debates.¹⁴

To that end, I offer here a preliminary exploration of the "private side" of the nineteenth-century public health movement. The first section of this article examines the origins of domestic sanitary science; the second section examines methods of popular health education; the third section examines the chief principles of domestic hygiene; as popularized in the decades roughly from 1860 to 1900; the fourth section looks at the assimilation of the germ theory into the domestic sanitarians' vision of the house as a vector of disease; the fifth section assesses how deeply the new domestic hygiene penetrated middle-class thought and behavior in the late nineteenth century; and the sixth section deals with the transition from voluntary to compulsory initiatives in public health. In assaying this rich material, I

¹³Historians have commented on the relatively rapid public assimilation of the germ theory, as well as the similarity between sanitarian and bacteriological prescriptions for preventive hygiene. However, no one has systematically explored how the popularization of sanitary science laid the groundwork for the acceptance of the germ theory. See Howard D. Kramer, "The germ theory and the early public health program in the United States," *Bull. Hist. Med.*, 1948, 22: 233–47, esp. pp. 235, 241; and Andrew McClary, "Germs are everywhere: the germ threat as seen in magazine articles, 1890–1920," *J. Amer. Cult.*, 1980, 3: 33–46. (For my observation here about the growing tension between elite and popular versions of scientific truth, I am indebted to John Burnham's very interesting study of popular science education, *How Superstition Won and Science Lost: Popularizing Science and Health in the United States* [New Brunswick, New Jersey: Rutgers University Press, 1987].)

¹⁴I am grateful to Gretchen Condran for sharing her work in progress on this topic with me. She and Samuel Preston are preparing a review essay on the problem of personal hygiene and the mortality transition.

have used printed primary sources representing the national, indeed international, culture of late nineteenth-century sanitary science; but for the sake of narrative focus, the manuscript material is drawn chiefly from Philadelphia.¹⁵

THE ORIGINS OF DOMESTIC SANITARY SCIENCE

Attempting to ward off infectious disease by a careful domestic regimen was by no means a revolutionary concept to nineteenth-century Americans. Their Western European cultural heritage made them heirs to a centuries-old tradition of preserving health by keeping both body and home clean and infused with fresh air. The more specific ancestry of the concept of the "house disease" can be traced back to the practice of household cleanliness, disinfection, and quarantine common in pre-modern epidemics. In mid-eighteenth-century France, physicians reworked these traditional concerns with new physiological and chemical knowledge to create the Enlightenment science of hygiene. The hygienists' emphasis on the atmosphere's role as a carrier of disease made the provision of pure air and the control of foul odors the foundation of the early nineteenth-century public health movements in France, England, and the United States.¹⁶

Still, before the middle of the nineteenth century, the public health movement had relatively little to offer the individual citizen concerned with avoiding infectious diseases. Hygiene manuals devoted only a few pages to measures for keeping clear of contagion, devoting the bulk of their text to the role of personal regimen and of constitutional tendencies in the production of illness. In other words, when advice givers considered the issue of individual responsibility for illness, infectious diseases seemed among the least preventable, given the pervasive nature of atmospheric contagion: the only way to avoid the dangers of a corrupt atmosphere was to maintain one's general health, live in a dry, well-ventilated house, and avoid people who were obviously ill. Benjamin Rush summed up the thrust of conven-

¹⁵ The choice of Philadelphia was dictated largely by the richness of its archival sources for the nineteenth century. I have no reason to believe that the evolution of popular attitudes and behavior in Philadelphia was significantly different from that in other large eastern cities of the period.

¹⁶ Oswei Temkin, "An Historical Analysis of the Concept of Infection," in his collection of essays *The Double Face of Janus* (Baltimore, Maryland: Johns Hopkins University Press, 1977), pp. 456–71, provides an excellent overview of traditional views of infection. Noting the consistent association between foul smells, decay, and disease, he notes, "It is remarkable how our modern terminology has remained within the orbit of ancient and medieval imagery" (p. 461). Carlo M. Cipolla, *Fighting the Plague in Seventeenth-Century Italy* (Madison: University of Wisconsin Press, 1981), esp. pp. 76–78, discusses house quarantine of plague victims during the Tuscan epidemic of 1630–31. On the French hygienists, see Alain Corbin's fascinating account, *The Foul and the Fragrant: Odor and the French Social Imagination* (Cambridge, Massachusetts: Harvard University Press, 1986). On hygienic traditions prior to the 1800s, see James C. Riley, *The Eighteenth-Century Campaign to Avoid Disease* (New York: St. Martin's Press, 1987); and Ginnie Smith, "Prescribing the Rules of Health," in *Patients and Practitioners: Lay Perceptions of Medicine in Pre-Industrial Society*, ed. Roy Porter (Cambridge and New York: Cambridge University Press, 1985), pp. 249–82.

tional wisdom when he wrote to his wife during the 1793 yellow fever epidemic, "There is but one preventative that is certain, and that is 'to fly from it.'"¹⁷

The Home Book of Health and Medicine, published by an anonymous "physician of Philadelphia" in 1835, suggests to what a small extent domestic conduct was seen to be linked with specific diseases. In a treatise of 619 pages, the author spent only a few paragraphs, under the headings "Air" and "Cleanliness," enjoining his readers to keep their homes, particularly their cellars, clean, dry, and well-ventilated. The only specific diseases mentioned in connection with poor domestic hygiene were typhus and cholera, which the author unequivocally categorized as diseases of "poverty and low-life." When "persons in easy circumstances" fell ill of cholera, he concluded, it was due not to poor home conditions but to some irregularity in personal regimen such as improper diet, intemperance, or fatigue. Before the 1860s, then, what public health authorities later began to call house diseases were chiefly seen as being associated with the poor, and the routines of preventive domestic hygiene remained simple and relatively insignificant.¹⁸

Between 1860 and 1880, changes in both the scientific understanding of disease and the material circumstances of middle-class home life elevated domestic prevention of disease to a new importance. New insights from physiology, pathological anatomy, and epidemiology allowed the disaggregation of the vague categories of fevers and fluxes inherited from the eighteenth century into discrete pathological entities. Appreciation of the specificity of infectious diseases was accompanied by a growing conviction of their preventability. All the evidence compiled by the clinical, pathological, and epidemiological investigations of the day seemed to verify the same focal points of infection: corrupted air and impure water. "Sanitary science," as the preventive formulations came to be termed, did not reject the older atmospheric theory of infection, but rather expanded and elaborated upon it. While air remained the first cause usually invoked to explain the spread of disease, water figured as an increasingly important factor after the famous studies of William Budd and John Snow in the late 1840s showed how cholera spread through tainted water supplies. Budd provided additional evidence of the same mode of transmission for typhoid fever. Public health authorities devised a new category of diseases—"zymotic diseases," which

¹⁷ The Rush letter is quoted in Whitfield J. Bell, Jr., *The College of Physicians of Philadelphia: A Bicentennial History* (Canton, Massachusetts: Science History Publications, 1987), p. 28. My comparative remarks about pre-1850 hygiene manuals are based on a reading of volumes such as Bernhard C. Faust, *Catechism of Health for the Use of Schools, and for Domestic Instruction* (Dublin, 1794; New York: Arno Press, 1972); Robert W. Johnson, *Friendly Cautions to the Heads of Families and Others . . .*, 3d ed. (Philadelphia: James Humphreys, 1804); and Caleb B. Ticknor, *The Philosophy of Living; or, the Way to Enjoy Life and Its Comforts* (New York: Harper & Bros., 1836).

¹⁸ *The Home Book of Health and Medicine: A Popular Treatise on the Means of Avoiding and Curing Diseases . . .* (Philadelphia: Key & Biddle, 1835); quotations are from pp. 382, 503. The advice given in general books on domestic affairs, such as Catharine E. Beecher's widely read *Treatise on Domestic Economy*, was even less detailed than that found in the family medical manuals of this type.

included cholera, typhoid, diphtheria, smallpox, measles, and scarlet fever—to denote illnesses caused by impure air and water.¹⁹

While Anglo-American physicians generally agreed on certain causal associations—that decaying organic matter led to putrefaction, which produced fermentation and its characteristic disease symptoms in the body—they still differed sharply over how zymotic diseases originated and spread. Some disorders, such as smallpox and other eruptive fevers, seemed clearly to spread from person to person through the direct transfer of contagious matter. Others, such as typhoid, seemed capable of originating *de novo* under certain atmospheric conditions and infecting individuals through the mechanism of corrupted air; once established, the disease then spread through fecal contamination of the water supply. However, though doctors fiercely debated such matters in their medical societies and journals, when it came time to advise the public, most of them warned indiscriminately against the dangers of infection and contagion and advocated the same safeguards for both. The various doctrines of contingent contagionism, which sought to reconcile the critical role of the atmosphere with the growing evidence for individual transmission of contagion, became the foundation of domestic sanitary science in the 1870s and the 1880s.²⁰

As public health authorities traced out the complex routes of atmospheric and water pollution, they became increasingly aware of the role that certain domestic practices played in the spread of disease. New scientific evidence implicated changes in the middle-class household, especially its plumbing system, as a key factor in the rising rates of zymotic diseases. Ironically, “progress,” namely the greater availability of running water and the growing popularity of the water closet, had created a sewage crisis of frightening proportions. The civil engineer and authority on house drainage William Paul Gerhard succinctly explained the problem:

¹⁹ The literature on changing concepts of disease in this period is vast. For my discussion in the following paragraphs I am heavily indebted to the following works: John M. Eyler, *Victorian Social Medicine: The Ideas and Methods of William Farr* (Baltimore, Maryland: Johns Hopkins University Press, 1979); Margaret Pelling, *Cholera, Fever, and English Medicine, 1825–1865* (New York: Oxford University Press, 1978); Charles E. Rosenberg, *The Cholera Years: The United States in 1832, 1849, and 1866* (Chicago: University of Chicago Press, 1962); *idem*, “The Therapeutic Revolution” in Morris J. Vogel and Charles E. Rosenberg, eds., *The Therapeutic Revolution: Essays in the Social History of American Medicine* (Philadelphia: University of Pennsylvania Press, 1979), pp. 3–25; Oswei Temkin, “The Scientific Approach to Disease: Specific Entity and Individual Sickness,” in *Double Face of Janus*, pp. 441–55; and John Harley Warner, *The Therapeutic Perspective: Medical Practice, Knowledge, and Identity in America, 1820–1885* (Cambridge, Massachusetts: Harvard University Press, 1986).

²⁰ F. S. B. de Chaumont, “Hygiene,” *Sanitary Record*, 5 December 1874, pp. 398–99, provides an excellent example of sanitarian eclecticism; in his table of the zymotic diseases, impure air, contaminated water, and direct contagion were implicated in the etiology of each disease. George Wilson’s comment on the indiscriminate use of the terms *infection* and *contagion* (see n. 3 above) reinforces this observation. Margaret Pelling argues that by the mid-1860s, the majority of English physicians had adopted some version of “contingent contagionism.” Rosenberg reached much the same conclusion in his study of cholera in the United States. See Pelling, *Cholera, Fever, and English Medicine*, esp. pp. 295–310; Rosenberg, *Cholera Years*, esp. pp. 192–99. The desire to straddle the middle ground explains the continued popularity of Murchison’s “pythogenic theory” of fever and Pettenkofer’s version of contingent contagionism, which allowed for both direct and indirect modes of contagion.

In city dwellings the ample supply of water, which in turn serves as a vehicle for transporting refuse matters, and the more general introduction of the convenient plumbing fixtures, led, owing to the leaky condition of brick or earthenware drains under houses, to a sewage-sodden condition of the soil under basements. This is true not only of the vast number of buildings erected by shrewd speculators, but it applies alike to the palatial mansions of the rich. Indeed, the death-rate from zymotic diseases increased, not only in houses with damp cellars, basements, and foundation-walls, but principally in those elaborately planned and richly furnished residences of the better class, where innumerable stationary washbowls, defective in arrangement and tightly enclosed by decorative cabinet-work, were scattered in bedrooms all over the house.²¹

The prevalence of damp cellars, foul odors, and leaky drains even in the best of homes convinced sanitarians that the "modern conveniences" of water closet and sink were as serious a public health hazard as was the more blatant uncleanness of the laboring classes. They widened the association between contagion and defective household arrangements, which had formerly been limited to typhus and cholera, to include many common infectious ills that affected rich and poor alike. The expanded category of house diseases included typhoid, which was spread by fecal contamination of the water and air; diphtheria and other diseases involving sore throats, which were thought to be caused by foul air or sewer gas released by faulty plumbing; and highly contagious diseases such as measles and scarlet fever, which spread due to careless domestic nursing practices. (Although still regarded as a constitutional disease, consumption was also frequently linked with damp and poorly ventilated dwellings.)

Given the large role they accorded faulty household arrangements in the spread of such serious diseases, domestic sanitarians recognized voluntary reformation of the private sphere as one of the most direct and effective means of improving public health. This emphasis not only stemmed from the domestic sanitarians' conviction that pollution and contagion began in the home; it also reflected the realistic assessment that municipal authorities could not always be relied upon to uphold the highest sanitary standards. The householders needed to look after their own interests, particularly as their families became ever more dependent on common services such as sewers and water supplies for the maintenance of health. In an era when the state's public health powers were still rudimentary, domestic sanitary science restored a sense of control to the individual homeowner. As Joseph Edwards put it in 1882, "You cannot look into the sewer and see whether it is clean or not. But, into all the arrangements of your own individual house

²¹ William Paul Gerhard, *The Drainage of a House* (Boston: Rand Avery Co., 1888), p. 4. For a good historical survey of the "wastewater crisis" of the late nineteenth century, see Joel Tarr, James McCurley, and Terry F. Yosie, "The Development and Impact of Urban Wastewater Technology," in Melosi, ed., *Pollution and Reform*, pp. 59–82.

you can peer at all times, and can plainly see whether they are right or not."²²

Popular health education advanced the sanitarians' broader political agenda as well, because a well-educated public would be more likely to support strong boards of health in their legislative battles to clean up the urban environment. Like reformers struggling against municipal corruption who needed "not only the sympathy, but also the active and hearty cooperation of the masses" to succeed, Edwards observed, it was "equally impossible for any board or boards of health to vanquish disease, unless they are thoroughly aided by the intelligent assistance of the public."²³

METHODS OF POPULAR HEALTH EDUCATION

Fortunately for the sanitarians' purposes, their commitment to popular education coincided with the availability of increasingly inexpensive books, magazines, newspapers, and pamphlets to circulate sanitary information to the public. Beginning in the 1870s, scores of domestic hygiene manuals were written. Some, by prominent public health leaders, were published by major presses; others, by lay health enthusiasts, were privately printed. These manuals ranged from highly specialized technical tomes that thoroughly expounded the scientific rationale for the author's recommendations, to short, simple summaries of proper domestic behavior that supplied only the most rudimentary explanations for the advice offered.²⁴

At one end of the spectrum were specialized treatises, aimed at both a professional and a lay audience, on topics such as sanitary plumbing or disinfection. For example, William Eassie's *Sanitary Arrangements for Dwellings* (1874), an English volume frequently cited on both sides of the Atlantic, was "intended for the use of officers of health, architects, builders, and householders." More general manuals, such as Henry Hartshorne's *Our Homes* (1880), which appeared in Blakiston's American Health Primers series, contained chapters on varied matters of concern to the householder, from building or choosing a home to creating a "home hospital" for the care of contagious illness. Domestic encyclopedias and family medical guides, such as *Wood's Household Practice of Medicine, Hygiene, and Surgery* (1880), which was intended for the use of "families, travelers, seamen,

²² Joseph F. Edwards, *How We Ought to Live* (Philadelphia: H. C. Watts & Co., 1882), p. 151.

²³ *Ibid.*, p. 407.

²⁴ A few books and articles dating from before 1875 appeared under the heading "Habitations" in the first series of the *Index-Catalogue of the Library of the Surgeon-General's Office, United States Army* (Washington, D.C.: Government Printing Office, 1880-95), but the real flood began in the late 1870s and 1880s. Home hygiene was a popular topic among sectarians as well as "mainstream" physicians. See, for example, the hydropathic version of the sanitarian message included in *The Household Manual* (Battle Creek, Michigan: *Health Reformer* Office, 1875).

miners, and others," contained condensed versions of the same sanitarian advice.²⁵

The concern with domestic hygiene carried over into the periodical literature as well, including ladies' magazines and popular science journals. The venerable *Godey's Lady's Book* contained short homilies on home health matters, and the more up-to-date *Ladies' Home Journal*, which began publication in 1883, had regular features on the prevention and management of infectious diseases. From its first issue in 1872, the *Popular Science Monthly* carried articles on sanitary plumbing, disinfection, and the germ theory of disease. In 1875, the *Atlantic Monthly* carried a widely read series of articles on domestic hygiene by the sanitary engineer George Waring. By the 1890s, even weekly religious newspapers such as the New York City *Independent* had columnists covering public health issues.²⁶

The format and content of this published advice suggests that it was designed to provide guidance at certain common junctures of family life when health issues were particularly salient, such as when a family was deciding to build or rent a house, nursing a case of infectious disease in the home, or caring for a newborn baby. Clearly addressed to middle-class interests and pocketbooks, books and magazines furnished a constant flow of information about domestic hygiene to which individuals and families attended when the interest or need arose.

A second strand of popular education, far more episodic and intense in nature, was prompted by the fear of epidemics. The recurrent outbreaks of cholera spurred the most aggressive educational campaigns in American cities; periodic outbreaks of the much-dreaded childhood diseases scarlet fever and diphtheria also prompted special educational efforts. The outbreak of such fearful diseases presented unparalleled educational opportunities that public health authorities were quick to exploit: however fleetingly, epidemics brought the need for prevention to the whole community's attention.

These mass educational crusades arose on short notice and lasted only briefly, yet they reached more people and infused their message with a deeper sense of urgency than did the more voluminous advice literature. The chief form of "crisis education" was the circular, a brief fact sheet on disease prevention distributed *gratis* by municipal and state health depart-

²⁵William Eassie, *Sanitary Arrangements for Dwellings, Intended for the Use of Officers of Health, Architects, Builders, and Householders* (London: Smith Elder & Co., 1874); Henry Hartshome, *Our Homes* (Philadelphia: Presley Blakiston, 1880); Frederick A. Castle, ed., *Wood's Household Practice of Medicine, Hygiene, and Surgery*, 2 vols. (New York: William Wood & Co., 1880). The quotation from the latter volume is taken from the title page. Volume 1 has several chapters on house construction and domestic hygiene.

²⁶George Waring's articles were reprinted in book form as *The Sanitary Drainage of Houses and Towns* (New York: Hurd & Houghton, 1876). Charles Chapin was speaking particularly of Waring's series when he noted that it made New Englanders fear sewer gas "perhaps more than they did the Evil One." Quoted in Cassedy, "Flamboyant Colonel Waring," p. 166.

ments. The circular's text was usually published in the daily newspapers as well. These two- or three-page tracts presented short, simple versions of the sanitarian gospel that assumed literacy, but little else, of their readers. Health department circulars and newspaper notices were probably the chief means by which detailed information about infectious diseases reached the working classes of the nineteenth-century American city.²⁷

THE PRINCIPLES OF DOMESTIC HYGIENE

At the core of popular sanitarian writings about the home was a vision of life as an intricate process of respiration, consumption, excretion, and decay, in which the individual body figured prominently as a pollutant. Sanitarians believed the waste products of the body, particularly respired air and excrement, to be poisonous. As Mary F. Armstrong warned her readers in a tract written for the Hampton Institute, "everything which is thrown out from the human body is unclean, and becomes at once dangerous to human life."²⁸ When human beings were packed too closely together, as in large cities, the sum total of their wastes was truly horrifying to contemplate. Henry Hartshorne, a Philadelphia medical professor and prominent hygiene authority, eloquently summed up this perspective in his domestic manual *Our Homes*:

Apart from human interference, there is in nature a balance of formation and destruction, of life and death, food and waste, making a perfect natural economy everywhere. Man comes in with his artificial constructions, and sweeps away much of this economy of nature. . . . Hence comes foulness of the earth, water, and air; stench, miasma, pestilence. A guerilla warfare seems to be waged all around the invader of nature. . . . We must maintain or restore the original balance of primeval nature, by providing for the reappropriation of the products of life and the results of death and decay around us.²⁹

In righting this balance, the hygiene of the home played a critical role, for it was there that human beings spent the bulk of their time breathing, secreting, and excreting. Careful domestic hygiene was necessary to ensure the provision of pure "intake," that is, clean water, food, and air, and safe

²⁷ Numerous examples of these circulars, from boards of health in Boston, New York, Philadelphia, and Providence, can be found. For example, the Library of the College of Physicians of Philadelphia has *Sanitary and Preventive Measures: Disinfectants, How to Use Them, or What May Be Done by the Public to Guard against Yellow Fever and Diseases Common to Summer Months*, prepared by the Sanitary Committee of the Board of Health of Philadelphia (Philadelphia: E. C. Markley & Son, 1878); the History of Medicine Division, National Library of Medicine, has one from the Massachusetts State Board of Health entitled *Suggestions for Preventing the Spread of Scarlet Fever* (n.p., n.d.). This brochure has no date, but is stamped as received at the Surgeon General's Office, U.S. Army, in 1888. Of course, broadsides and circulars were traditionally used by pre-modern health officials to educate the public in times of plague and other epidemic diseases.

²⁸ Mary F. Armstrong, *Preventable Diseases*, Hampton Tracts for the People, Sanitary Series, no. 3 (Hampton, Virginia: Hampton Institute Press, 1878), p. 5.

²⁹ Hartshorne, *Our Homes*, p. 9. See Christopher Hamlin, "Providence and putrefaction: Victorian sanitarians and the natural theology of health and disease," *Victorian Studies*, 1985, 28: 381–411, for an interesting discussion of the Victorian concept of putrefaction.

removal of the "outgo," or human wastes in the form of respired air and sewage. Otherwise, vitiated and corrupted air, poisonous exhalations, and dangerous discharges would be trapped in the home and given a deadly opportunity to work on its inhabitants, who ate and slept in blissful ignorance of the hazards surrounding them. The man who feels secure in his "castle," wrote the anonymous author of the *Bazar Book of Health* in 1873, "shuts himself up in it with his worst enemies." The prominent sanitarian F. S. B. de Chaumont speculated in 1874 that "it might be a question whether or not in many cases it would be better to be without a house at all, than remain exposed to the numerous causes of disease arising within it."³⁰

To guard the home against infection, sanitarians concentrated chiefly on four areas of domestic conduct: proper construction and maintenance of the house itself, especially ventilation and plumbing, to ensure pure air and an absence of dangerous sewer gases; careful home nursing of patients with contagious diseases, to prevent the spread of infectious material thrown off by their bodies; a specialized hygiene of the nursery, to protect children from the deadly diseases of childhood; and general housekeeping measures designed to ensure cleanliness.³¹ Some sanitarian measures merely expanded and updated older hygienic conventions, such as the concern for pure air and the isolation of those ill with infectious diseases; others, such as the emphasis on sanitary plumbing and pure water, represented a response to new scientific information about the role of fecal contamination in causing cholera and typhoid.³²

In addition, the sanitarians' prescriptions concerning domestic hygiene drew heavily upon their prior experience with institutions, particularly hospitals. The emphasis on careful building design to ensure healthful living conditions, the precise ratios of fresh air needed per person to disperse respired gases, the elaborate techniques for fumigating and disinfecting rooms, all can be found in the hospital reform literature of the period. Florence Nightingale's *Notes on Nursing*, which attempted to instruct women in "every day sanitary knowledge," was a deliberate attempt to take the lessons of the hospital into the home. In many less obvious ways,

³⁰ *The Bazar Book of Health* (New York: Harper & Bros., 1873), p. 17 (the author identified him- or herself as a physician); de Chaumont, "Hygiene," p. 397. Note the similarity between the laws seen to govern the home and the traditional economy of the individual body in health and disease, as described so well by Rosenberg in "Therapeutic Revolution." Rosenberg uses the terms *intake* and *outgo* to describe the balance between individual and environment that was central to maintaining health.

³¹ The following summary of the principles of domestic hygiene is based on some fifty manuals published between 1870 and 1900 that I found in the Library of the College of Physicians of Philadelphia, the National Library of Medicine, the Drexel University Library, Philadelphia, Pennsylvania, and the Van Pelt Library of the University of Pennsylvania, Philadelphia. With few exceptions, I confined my survey to books written by Americans and American editions of English manuals.

³² See Temkin, "Concept of Infection," and Rosenberg, "Therapeutic Revolution." As Temkin points out, the concept of disease as pollution is a very ancient one. Mary T. Douglas, in *Purity and Danger: An Analysis of Concepts of Pollution and Taboo* (London: Routledge & Kegan Paul, 1966) argues that taboos about cleanliness and uncleanness are a fundamental aspect of human societies.

domestic sanitary science involved the transfer of technologies for ventilation and disinfection from large-scale to small-scale human habitations.³³

The first and most important set of directives centered on building and maintaining the home: it must be sited properly, on dry soil; and so oriented as to ensure the maximum amount of what domestic sanitarians were fond of calling “natural disinfectants,” namely fresh air and sunshine. In place of the advice simply to secure a “constant supply of fresh air,” which sufficed in older hygiene manuals, painstaking attention was given to the proper proportioning of rooms, especially sleeping chambers, to ensure enough cubic feet of air per occupant to dilute the exhaled waste materials. In his book, Joseph Edwards urged that windows and doors be as large as possible, to replicate the healthy experience of living outdoors: “The larger you make your openings, the nearer will your house approach a tent.” Many manuals included instructions on how to rig windows with simple “ventilators” (e.g., by wedging the window open and placing a board in front of it to force the air upward, or by tilting an upper window in at the top) to ensure the circulation of fresh air without creating dangerous drafts.³⁴

“Ours is the Age of Plumbing,” emphasized Henry Hartshorne, and even the simplest hygiene manuals included lengthy and detailed discussions of the complexities of traps, water closets, and soil pipes. The essential goals of sanitary plumbing were straightforward—to get pure water into and human wastes out of the house without contamination of air or water—but the technological means to accomplish them were exceedingly complex. Domestic sanitarians considered the bare minimum of precautions to include complete separation of the drinking water and waste water systems; water closets that flushed thoroughly to prevent the putrefaction of wastes; watertight pipes to conduct wastes into the sewer; traps on all drains to prevent the discharge of sewer gas back into the room; and a special soil pipe running up the side of the house and venting above roof level, to allow the safe conduct of gases away from the home. Alfred Carroll, writing in a Staten Island missionary paper in 1878, confidently claimed that “with one of these simple appliances out-of-doors, a cellar tight and dry, and indoor drain pipes without material leakage, domestic life would be secure from the worst of its invaders.”³⁵

Sanitary authorities recommended hiring only the best plumbers and supervising their work carefully. To this end, J. Pridgin Teale designed his

³³ Florence Nightingale, *Notes on Nursing: What It Is, and What It Is Not* (New York: D. Appleton & Co., 1865); quotation is from p. 3. See Charles E. Rosenberg, *The Care of Strangers: The Rise of America's Hospital System* (New York: Basic Books, 1987), esp. chap. 5, for a discussion of the hospital reform movement.

³⁴ Beecher, *A Treatise*, p. 273; Edwards, *How We Ought to Live*, p. 158. Edwards was probably invoking the Civil War experience that temporary tent hospitals had lower mortality rates than their permanent counterparts. For a typical description of a do-it-yourself window ventilator, see Roger S. Tracy, *Hand-book of Sanitary Information for Householders* (New York: D. Appleton & Co., 1884), p. 17.

³⁵ Hartshorne, *Our Homes*, p. 101; Alfred Carroll, “The enemy in the air,” *Sanitarian*, 1878, 6: 255. The latter article was reprinted from the *Messenger*, which the *Sanitarian's* editor described as “an enterprising missionary paper of Staten Island.” *Sanitarian*, 1878, 6: 253.

"pictorial guide to domestic sanitary defects" so that the homeowner might "test every sanitary point, one by one, and as he goes round book in hand, . . . catechise his plumber, his mason, or his joiner." Those renting or buying a home were advised to use the "peppermint test," which involved introducing oil of peppermint into a water closet and sniffing to see if the aromatic odor leaked out elsewhere in the house, a sure sign of faulty plumbing. An English physician recommended that his medical brethren write out directions for the test as they did a prescription, for though it was no substitute for a thorough plumbing inspection, it was "an admirably simple means of arousing a householder from the slumbers of a false security, from a fool's paradise, and of establishing the evident necessity of calling in skilled assistance."³⁶

Similarly, the writers of manuals passed on detailed instructions for testing and purifying drinking water, warning that appearance, taste, and smell were not enough to determine the safety of water. In the summer, and during epidemics, they advised prudent householders to filter or boil all drinking water. Domestic manuals often included instructions for constructing simple home filters of sand, charcoal, and cloth. "But really suspicious water should, before using it for drinking or cooking, be boiled as well as filtered," advised Hartshorne in 1880.³⁷

In an era when hospitals catered primarily to the poor and friendless, having a family member sicken with an infectious disease posed a special threat to the domestic environment. Hygiene manuals routinely included a chapter on home nursing, which spelled out the measures to be followed to create a home hospital that would simultaneously aid the patient's recovery and protect others in the household from contagion. A light and airy chamber was to be chosen and stripped of all carpeting and drapes, a sheet drenched in a strong disinfectant such as carbolic acid hung at the doorway, and liberal use of disinfectants made throughout the house. Last and most important, the patient's wastes were to be *immediately* disinfected and removed from the home.³⁸

The proper use of disinfectants received lengthy explication in both domestic hygiene manuals and public health circulars. Public health authorities recommended employing disinfectants both as a daily precaution against disease and as a preventive in the sickroom. In place of the old, odoriferous techniques such as burning sulfur, which had sufficed for previous generations, domestic sanitarians extolled the virtues of the many new chemical disinfectants developed since the 1840s, including carbolic acid,

³⁶J. Pridgin Teale, *Dangers to Health: A Pictorial Guide to Domestic Sanitary Defects* (London: Churchill, 1879), p. 9; R. T. Hildyard, "Influence on sanitary progress which medical men might exercise in their private practice," *Trans. Sanitary Inst. Great Britain*, 1883, 4: 109.

³⁷Hartshorne, *Our Homes*, p. 100.

³⁸For a representative set of instructions on how to operate a home hospital, see Edwards, *How We Ought to Live*, pp. 395–401.

sulfate of iron (also known as copperas), sulfate of zinc, chloride of iron, and permanganate of potash. Circulars and home hygiene manuals described at length the properties of the various disinfectants and gave recipes for inexpensive solutions to purify the air of a sickroom, rid the skin of contagious matter, disinfect the excreta of the ill, fumigate clothing and linens, and cleanse the plumbing system. Well into the early 1900s, disinfection was presented as one of the most important precautions against disease that householders could practice, "lest by neglect the health of the family may suffer," as a New Hampshire State Board of Health circular stated in 1885.³⁹

Home nursing of childhood diseases required special precautions, since infectious diseases such as scarlet fever and diphtheria took such a high toll among the young. The writers of manuals advised parents to send their other children away immediately when a sibling fell ill, and to be very painstaking in washing and boiling the latter's bed linen and clothing. The contagious matter produced by eruptive diseases was believed to be especially hard to destroy and easily transmitted by ordinary objects. Joseph Perry told a standard cautionary tale: A cap was worn by a boy who developed scarlet fever; it hung in his sickroom, and after his funeral, it was "put away in a closely covered tin box without disinfecting." Two years later, the hat was removed and worn by the boy's younger brother, who within three days fell sick of the same disease, furnishing to Perry and his readers conclusive proof of the contagion's "tenacity." In a circular on scarlet fever published in 1888, the Massachusetts State Board of Health cautioned that the disease could be transmitted by "air, food, clothing, sheets, blankets, whiskers, hair, furniture, toys, library-books, wallpaper, curtains, cats, [and] dogs."⁴⁰

Because of children's vulnerability to infectious diseases, the hygiene of the nursery necessitated special attention to ventilation, plumbing, disinfection, and pure water. Parents were told to place the nursery on an upper floor and keep its furnishings sparse. The importance of location was illustrated by a story in an 1888 manual about a woman whose children kept having "recurring diphtheric symptoms." The family doctor discovered that she kept them in a basement workroom during the day, and after he had her move the nursery upstairs, "the change was almost magical." The writers of manuals advised parents to keep their children out of doors as much as possible, and to place them in separate beds so that their "exhalations" would not mingle. Feeding utensils, especially for infants, were to be

³⁹ New Hampshire State Board of Health. *Disinfectants and Their Use* (Concord, New Hampshire: Parsons B. Cogswell, 1885), p. 5; see Hartshorne, *Our Homes*, pp. 130–36, for a standard discussion of disinfection. One of the distinctive tenets of the "new public health" was its rejection of the late nineteenth-century belief in disinfection. See Charles V. Chapin, "The fetch of disinfection," *JAMA*, 1906, 47: 574–80; and *idem*, *The Sources and Modes of Infection* (New York: Wiley; London: Chapman and Hall, 1910).

⁴⁰ Joseph F. Perry, *Health in Our Homes* (Boston: Thayer, 1887), p. 403; Massachusetts Board of Health, *Suggestions*, p. 1.

kept scrupulously clean and the water and milk for infants' use carefully boiled or filtered as a precaution against illness, particularly the dreaded "summer complaint," or infant diarrhea. Parents were also warned to check the health of the cows giving milk for their children, and to seek a source of clean, fresh milk that had not been allowed to stand for long.⁴¹

Finally, domestic hygiene manuals constantly emphasized the value of general cleanliness as a preventive against disease: the yard and cellar were to be kept dry and clear of "nuisances," dust and dirt to be swept up with a damp mop, the bedroom and bedclothes to be aired daily to rid them of "exhalations" (adults were also advised to sleep alone), and the house and plumbing periodically disinfected. Housewives were advised to replace heavy drapes and carpets with more easily cleaned curtains and rugs in order to prevent the accumulation of disease-producing dust. Warning her readers about the importance of such housekeeping details, Harriette Plunkett stated in her 1885 text *Women, Plumbers, and Doctors* that "eternal vigilance is the price of everything worth the having or keeping."⁴²

These discussions of plumbing, disinfection, and general housekeeping accorded enormous importance to small details of behavior. An unsigned editorial entitled "Unconsidered Trifles," which appeared in *Godey's Lady's Book* in 1872, made this point quite dramatically:

It cannot be too deeply impressed on people, especially the young, that very few real trifles exist in life; that is, there are very few actions, habits, or words which carry with them no consequences. . . . That ditch at the bottom of your garden—well, there is no denying that it smells badly enough in certain winds; but that is a mere trifle—a thing you cannot be expected to bother about when you have so much more important work on hand in the planning of your new conservatory. . . . The ditch is a trifle compared to the importance of such pursuits—a trifle, however, that brings diphtheria and typhus into your pretty house and takes off your children like sheep with the rot.⁴³

Such heavy-handed attempts to inspire guilt and anxiety most likely did not affect the two sexes equally. A rough gender division of hygienic labor is evident in the texts: men were directed to look after the general construction and upkeep of the home, including the plumbing and the cellar, while women were expected to superintend the hygienic aspects of home nursing, child care, and housekeeping. Of course, both sexes had ways in which they could delegate this responsibility: men could hire plumbers or architects to make the house safe, and women could have domestic servants do the heavy cleaning. However, both male and female authors tended to

⁴¹ Emma C. Hewitt, *Queen of the Home* (Philadelphia: Miller Magee Co., 1888), p. 112.

⁴² Harriette Plunkett, *Women, Plumbers, and Doctors: or, Household Sanitation* (New York: D. Appleton & Co., 1885), p. 43.

⁴³ "Unconsidered trifles," *Godey's Lady's Book*, 1872, 89: 45. The author's invocation of typhus is rather odd, since it was most emphatically a disease associated with the homes of the very poor; families with conservatories would be more likely to fear typhoid, so perhaps she confused the two.

assume that their female readers had a greater responsibility for and interest in preserving health because their lives were more closely tied to home and family. As Benjamin Richardson, the patron saint of domestic sanitarians, explained, "The men of the house come and go," while "the women are conversant with every nook of the dwelling, from basement to roof, and on their knowledge, wisdom, and skill the physician rests his hopes."⁴⁴

Given the continuing scientific controversy about how zymotic diseases actually originated and spread, domestic hygiene authors assigned to both individuals and families a surprisingly high level of responsibility for the prevention of infectious disease. The gospel of prevention emphasized that the vast majority of illnesses could be avoided by scrupulous adherence to a detailed hygienic code of behavior. "Many, very likely, will say that it is too much trouble to take the preventive measures advised," admitted Joseph Perry in his 1887 manual *Health in Our Homes*. "In the lives of all who study convenience so closely," he replied rhetorically, "there may come a time when, had those simple hints been observed, serious illnesses would have been averted, and possibly lives been spared."⁴⁵ In this fashion, the popularization of sanitary science intensified the public's belief in personal accountability for illness and reinforced their motivation to acquire ever more accurate information about preventing infectious diseases.

ASSIMILATION OF THE GERM THEORY

By the 1880s, when the germ theory of disease began to receive widespread explication in the popular press, domestic sanitarians had already instilled in the public a sense of responsibility for disease prevention. Not surprisingly, popular health writers were quick to report on the newest scientific theory, which John Shaw Billings neatly summarized in 1883 as the belief "that certain diseases are due to the presence and propagation in the system of minute organisms, which have no share or part in its normal economy."⁴⁶ Beginning in the late 1870s, popular writers began routinely to include germs in their list of household dangers that should be guarded against by proper domestic hygiene.⁴⁷ Some authors embraced the germ theory enthusiastically, as did Emma Hewitt, who declared in her 1888 text that "the study of the theory of germ proliferation has yielded amazing results in the way of furnishing the means of checking epidemics." Others took a more cautious position, emphasizing that the germ theory was still contro-

⁴⁴ Quoted in Plunkett, *Women, Plumbers, and Doctors*, p. 11.

⁴⁵ Perry, *Health in Our Homes*, p. 65.

⁴⁶ Quoted in Plunkett, *Women, Plumbers, and Doctors*, p. 148.

⁴⁷ The earliest mention of germs I found in my sample of manuals appeared in 1878 in Armstrong, *Preventable Diseases*. However, Charles Rosenberg has drawn my attention to a very brief account, in Catharine E. Beecher and Harriet Beecher Stowe, *The American Woman's Home* (1869; New York: Arno Press, 1971), pp. 421–22, of how "microscopic plants" cause zymotic diseases. Beecher and Stowe do not use the term *germ*, however.

versial, but at the same time insisting that its tenets supported the thrust of sanitarian recommendations. For example, after briefly summarizing the germ theory in his 1880 domestic hygiene manual, the English sanitarian George Wilson concluded, "Of far greater importance is to know that, whatever be the origin or mode of propagation of these diseases, they are to a very large extent controllable."⁴⁸

Although older sanitarians tended to be distrustful of what they felt to be the oversimplifications of bacteriology and of experimental methods generally, their hygienic formulations were easily expanded to incorporate germs into the schema of household dangers. Physicians might debate among themselves about the ability of microorganisms to cause disease, but popular hygiene writers had little trouble, at the level they had to explain matters, in associating dirt, infection, and germs. Damp cellars, noisome garbage, sewers, corrupted air, all could easily be portrayed as breeding grounds for these minute living particles; likewise, the individual "emanations" and "effete matter" thought to lodge in bedclothes and carpets could be seen as laden with disease germs. The ability of microorganisms to produce dangerous toxins or poisons could be easily assimilated into older notions of decay and putrefaction as sources of infection.

Moreover, those popular hygiene authors who were not physicians, a category that included most of the women writers, had none of the professional investment in established scientific explanations of disease that made it so hard for some physicians to accept the germ theory. The actual cause of the disease mattered little to them, so long as the same actions were effective in preventing it. The germ theory was rapidly incorporated into popular advice literature precisely because it supported what seemed to be common sense, that is, the already "proven" precautions of ventilation, disinfection, isolation of the ill, and general cleanliness. The public was given new information about germs in terms of what it already believed to be true about hygienic living conditions, and layers of old and new knowledge became tightly interlaced.

Thus the early popular understanding of germs closely followed the outlines of established sanitarian belief, suggesting that the dividing line between sanitarian and bacteriological conceptions of disease was never very sharp. The demand for usable knowledge about how to avoid infection outweighed the lack of scientific consensus about the etiology of disease. As a result, domestic sanitary science was not vanquished by bacteriology; rather it might more properly be said that the former appropriated the latter to its own uses. Contrary to the worst fears of sanitarians such as Benjamin Richardson and Florence Nightingale, the germ theory did not

⁴⁸ Hewitt, *Queen of the Home*, p. 225; Wilson, *Health and Healthy Homes*, p. 117. Wilson became a bitter critic of bacteriology in later life, but in this popular health manual he gives a short and respectful exposition of the germ theory.

vitate the connection between a clean, moral life and safety from disease. Instead, to quote the author Emma Hewitt, the germ theory "placed in the hands of every one, if not the power of destroying these germs, at least the power to prevent their proliferation" by the practice of "antiseptic cleanliness" in the home.⁴⁹

THE PRACTICE OF DOMESTIC HYGIENE

While it can easily be shown that the principles of domestic hygiene were widely circulated through the print media, it is difficult to prove that the specific actions called for by the domestic sanitarians were ever taken. Even middle-class urban dwellers, who frequently confided their health concerns in diaries and letters, rarely commented upon plumbing improvements, disinfectant use, or sickroom procedures. Still, it is possible by more indirect evidence to arrive at some informed conjectures about how middle-class Americans changed their domestic behavior in order to avoid infectious diseases in the 1870s and the 1880s.

The sanitary reclamation of some famous homes provides one line of evidence that domestic hygiene was taken seriously. In 1861, Queen Victoria's husband Albert, the prince consort, died of typhoid, "like a common Terling peasant," in the words of an indignant sanitarian; barely a decade later, in 1872, the Prince of Wales, heir to the English throne, nearly died of the same disease. Balthazar Foster drew the obvious conclusion in a lecture, "The Prince's Illness: Its Lessons," delivered in 1872: "Truly, ignorance of sanitary science is not confined to the poor, but flourishes even in the highest places." The royal typhoid cases prompted a thorough investigation of the sanitary condition of Windsor Castle and other royal dwelling places.⁵⁰

Americans were not spared their own national sanitary disgrace: when President Garfield was shot in 1881, some sanitarians attributed his failure to recover from his wounds to the unwholesome state of the White House. In November 1881, George Waring performed an inspection of the presidential mansion and found serious defects: disintegrated waste pipes soaked the basement with "foul matters," whitewash from the kitchen walls flaked off into the food, and a general state of damp and decay prevailed. Waring informed John Shaw Billings that "while they are free from some defects often found in the better class of houses in our cities, the plumbing appliances of the Executive Mansion do not conform to what are now accepted

⁴⁹ Hewitt, *Queen of the Home*, p. 225.

⁵⁰ S. Sneade Brown, *A Lay Lecture on Sanitary Matters* (Clifton, England: E. Austin, 1871), p. 15; Balthazar W. Foster, *The Prince's Illness: Its Lessons. A Lecture on the Prevention of Disease* (London: J. A. Churchill, 1872), p. 16. Windsor Castle was given a sanitary inspection in 1859, and its drainage was pronounced safe by Charles Murchison. See "The death of the prince consort," *Lancet*, 21 December 1861, p. 599. The Prince of Wales's illness led to a meticulous inspection of the lodges where he had stayed before his attack. See "Report of the *Lancet* Sanitary Commission on the State of Londesborough Lodge & Sandringham, in Relation to the Illness of H.R.H. the Prince of Wales," *Lancet*, 9 December 1871, pp. 828-31. The evidence found seemed to implicate faulty plumbing at Londesborough in the Prince's case.

as the necessary sanitary requirements of a safe dwelling." President Chester Arthur wanted the White House torn down, but due to a combination of Congressional cheeseparing and sentimental attachment to the old mansion, he had to settle for a thorough plumbing overhaul.⁵¹

While the sanitary reclamation of such famous houses confirms that domestic hygiene was taken seriously, the question still remains: how did ordinary people change their everyday behavior to avoid infection, and what results might that behavioral change have produced, in psychological, social, and demographic terms? To answer that question, it is useful first to identify the most important measures advocated by the domestic sanitarian creed: ventilation, disinfection, plumbing, water purification, and general cleanliness. Regarding each of these points, increasing consumer demand for so-called sanitary goods suggests that middle-class Americans took the gospel of domestic sanitary science to heart in the late nineteenth century.⁵²

Assuming that supply followed demand, the rush to develop and to patent sewer traps, toilet designs, window ventilators, and water filtration systems in this period suggests that entrepreneurs found a lucrative market among householders anxious to safeguard their families against infection. Such products began to proliferate in the 1870s, and with the popularization of the germ theory their numbers showed an explosive increase in the 1880s and the 1890s.⁵³ In the 1880s, companies specializing in sanitary services such as disinfection and water purification appeared in city directories, suggesting that there was a living to be made by appealing to the fear of house diseases. Significantly, advertising brochures for these goods and services echoed, in both content and tone, the domestic manuals of the period: in promoting their goods, inventors and entrepreneurs assumed a familiar-

⁵¹ George Waring to John Shaw Billings, "Report on the Improvement of the Sanitary Condition of the Executive Mansion," 7 December 1881, manuscript; History of Medicine Division, National Library of Medicine; William Seale, *The President's House: A History*, 2 vols. (Washington, D.C.: White House Historical Association, 1986) 1: 536–38. Plunkett, *Women, Plumbers, and Doctors*, p. 230, refers to the sanitary scandal at the time of Garfield's wounding. Of course, it seems clear now that Garfield's condition was the result of his doctors' failure to observe antiseptic procedures while examining his wounds.

⁵² I believe (although I will not elaborate on my opinion here) that the late nineteenth-century revolution in home design and home furnishings should also be read, at least in part, as a response to sanitarian precepts. Reform movements championing the abandonment of ornamentation in favor of simple rectilinear lines invoked the need for cleanliness; less cluttered rooms offered fewer hiding places for deadly dust. Likewise, a concern for dirt and dust prompted the shift in preference from room-sized carpets to area rugs that could easily be taken up and beaten outside, and to the use of tile, and later linoleum, in kitchens and baths. Note that Bushman and Bushman in "Early history of cleanliness," date the beginning of the "soap boom" that is, the use of soap for bathing, to the post-Civil War period. They do not mention the rise of popular sanitary science in their explanations for this phenomenon, but it certainly seems plausible that the two were related.

⁵³ My observations about the timing of these developments are based primarily on my research on patent applications done at the United States Patent Office in Alexandria, Virginia. In the patent search office, copies of all patents are categorized according to the type of process involved and filed together in boxes (e.g., Class 4, "Baths, Closets, Spittoons, and Sinks," Class 424, "Disinfection," and Class 410, "Water Filtration"). Within each class, the patents are filed by the year they were granted. A search of these and similar categories revealed that the products discussed here began to appear in the early 1870s, and their numbers increased dramatically in the 1880s and the 1890s. (I am deeply grateful to Don Garber for telling me about the U.S. Patent Office sources.)

ity with sanitarian precepts, indicating that such knowledge was indeed widespread, at least among the sort of people they expected to purchase their wares.

No doubt because of the sanitarian obsession with plumbing, devices aimed at protecting homes against sewer gas were among the earliest sanitary goods to appear on the market. Between 1870 and 1885, numerous sewer trap designs, as many as twenty-two a year, received patents, along with some remarkable designs for ornamental lamps that used sewer gas for illumination.⁵⁴ The marketing of sewer traps made effective use of the same kind of concepts and personal anecdotes employed by the domestic sanitarians. In an 1880 brochure advertising his "perfected sewer valve trap," William F. Downey recounted how he had been driven to invent the device—which he described proudly as "the most important invention of the 19th century"—after his wife almost died from diphtheria contracted in their poorly constructed new home.⁵⁵

An even more active area of innovation was the redesign of toilets to ensure more prompt and complete removal of human wastes. Hundreds of designs for water closets and flushing devices were patented in the 1870s and 1880s; the 1884 catalogue of the Meyer-Sniffen Company presented no less than thirty-three different versions of the sanitary water closet, from the simplest to the most elaborate. For those families reluctant to invest in a whole new toilet, the enterprising patent solicitor R. D. O. Smith advertised "an odorless water closet" that a plumber could attach to an old-fashioned hopper toilet. Civil engineers such as William Paul Gerhard and George Waring took advantage of the new concern about plumbing to promote their careers as expert inspectors and improvers of house drainage.⁵⁶

⁵⁴ I surveyed the *Annual Report of the Commissioner of Patents* (Washington D.C.: Government Printing Office) at five-year intervals from 1870 to 1890; 1 sewer trap was patented in 1870, 10 in 1875, 9 in 1880, 22 in 1885, and 18 in 1890. Under Class 4-221, "Ventilation, Sewer, Burner," there are a number of remarkable devices for burning off sewer gas, including one lamp designed by J. Eckhardt in 1892. Eckhardt wrote in his patent application, "It would be superfluous at this day to call attention to the deadly nature of sewer-gas to prove the value of any device by which it may be rendered innocuous [sic] even if not turned to use, as in the present invention." The Hagley Museum and Library's collection of trade catalogues from the same period document the wide variety of traps and piping available. Note that plumbing supply companies began to call their wares "sanitary goods" in the 1870s. See, for example, J. L. Mott Iron Works, *Price List of the Plumbing and Sanitary Department* . . . (New York: E. D. Slater, 1881), Trade Catalog Collection, Hagley Museum and Library, Wilmington, Delaware (hereafter, HC). Joseph D. Galloway, *Gasfitters and Plumbers' Companion* (Philadelphia: By the author, 1875), p. 55, noted that lead pipe was rapidly becoming unpopular as a water pipe, and was being replaced by galvanized iron, tin, and lead pipe lined with tin. The best houses, Galloway observed, were being fitted with "seamless brass pipe." Although he does not specifically mention health concerns, these were changes that sanitarians were urging at the time.

⁵⁵ [William F. Downey], *The Downey Perfected Automatic Sewer Valve Trap . . . The Deadly Enemy Conquered* . . . (Washington, D.C.: National Republican Printing House, 1880), title page, HC.

⁵⁶ Meyer-Sniffen Co., Ltd., *Illustrated Catalogue of Water-Closet and Bathing Arrangements for Public and Private Places* (n.p., 1884), HC; R. D. O. Smith, *The Odorless Water Closet* (n.p., 2 November 1875), HC; Sanitary Association of Philadelphia, *Guarding the Home: Skeletons of Our Homes*, Tract no. 1 (n.p., [1887]), HC. For an excellent account of how Waring turned sanitary science into an engineering career, see Cassedy, "Flamboyant Colonel Waring." For a general history of toilets, see Lawrence Wright, *Clean and Decent: The Fascinating History of the Bathroom and the Water Closet* . . . (New York: Viking Press, 1960), esp. pp. 200–216.

Not to be outdone by plumbers and sanitary engineers, manufacturers of domestic heating and ventilation devices emphasized the healthful aspects of their products. The designers of building and window ventilators were granted many patents. Henry Hartshorne noted in his 1880 text that "many different systems and apparatus for ventilation of rooms and houses have been invented, more or less ingenious and successful in attaining their end—Muir's, McKinnell's, Tobin's, Ruttan's, Hulin's, and a host of others." As did the designers of sewer traps, the promoters of ventilation devices used health claims to sell their wares. For example, in 1873 the Philadelphia firm of Charles Williams included in its promotion brochure for the "Golden Eagle" furnace a lengthy discussion of the dangers of overheated and poorly ventilated homes, stating, "That a pure atmosphere is necessary to preserve health we need not attempt to prove by reasoning—it is a truth universally known and acknowledged." *Boyd's Business Directory for Philadelphia, 1879* listed two businesses that specialized in ventilators, including one company that sold only Read's Patent Window Ventilator.⁵⁷

Disinfectants represented an even more fertile field than ventilating devices for commercial development. By the late 1860s, patent preparations were already being marketed so aggressively that the American Medical Association's Committee on Disinfectants warned against them. "In general these patented compounds, which will no doubt be largely multiplied, are made to smell and to sell, and are not founded on any hidden scientific knowledge unknown to the profession, and are not as good as less bulky, more established disinfectants." By the early 1880s, when George Sternberg began testing the germicidal properties of commercial disinfectants for the American Public Health Association, there existed scores of proprietary solutions, with fanciful names, to be tested: Little's Soluble Phenyle, Bromo-Chloralum, Phenol Sodique, Withers Antizymotic Solution, and the ubiquitous Listerine. Druggists' catalogues in the 1870s and 1880s listed both generic and proprietary disinfectants in small quantities suitable for household use.⁵⁸

Mechanisms for dispensing disinfectants were also a popular line for commercial development: during the 1870s and 1880s, inventors received

⁵⁷ Hartshorne, *Our Homes*, pp. 72–73; Charles Williams Company, *Heating and Ventilating* (Philadelphia: Longacre & Co., 1873), p. 8, HC; *Boyd's Business Directory for Philadelphia, 1879* (Philadelphia, n.p., 1879), p. 932. From my reading of patent applications and reports, it appears that ventilators were first developed for industrial use and were then modified for the home, another example of a "technology transfer" from the public to the private sector.

⁵⁸ "Report of committee on disinfectants," *Trans. AMA*, 1866, 17: 154. Preliminary reports of Sternberg's experiments were published in 1885, then reprinted in book form: The American Public Health Association, Committee on Disinfectants, *Disinfection and Disinfectants*. (Concord, N.H.: Republic Press Association, 1888). In his study, Sternberg made a point of testing only substances commonly available from druggists in small packets, and scores of products were available in this manner. For a representative drug catalogue, see W. H. Schieffelin & Co., *General Prices Current of Foreign and Domestic Drugs, Medicines, and Chemicals* (New York: Holt Bros., 1885), HC. The disinfectant Labarraque's Solution was developed for use in Paris dissecting rooms, and carbolic acid gained in popularity after Lister's famous experiments in the operating room, providing additional examples of the "technology transfer" from hospital to home.

patents for disinfectant pocket inhalers, disinfecting apparatus for toilets and slop jars, and disinfectant devices for sewers. Champions of chemical disinfection, such as the physician C. L. Cohn, who invented a device for toilets known as the Germicide, often spoke disparagingly of the "multiplying mechanical devices in plumbing, ventilation, etc." designed to protect the home. "*There is no safety or security in any other method,*" Cohn warned.⁵⁹

As companies that specialized in sanitary engineering and ventilation became more numerous, business concerns that specialized in disinfection also began to appear in large eastern cities. In 1879, the Philadelphia business directory listed several individuals whose chief business was selling disinfectants. By the middle 1880s, companies such as Tayman's Disinfectant and Fumigating Company of Philadelphia offered home services using their own patented method. Like C. L. Cohn, the Tayman Company disparaged traps and other such devices, saying, "experience abundantly proves that mechanical devices are insufficient, that we must seek the aid of chemistry and obtain some agent that will antagonize and destroy the seeds of diseases."⁶⁰

Moreover, in the 1880s and the 1890s companies began to market domestic filtration systems that saved the trouble of constantly having to boil drinking water. Private water companies served consumers in New York, Boston, and Philadelphia. The Hyatt Pure Water Company of Philadelphia marketed domestic water filters capable of cleaning from 1.5 to 8 gallons per minute. A list of patrons given in an 1890 brochure included such prominent Philadelphians as the publisher Alexander McClure and the banker Anthony J. Drexel. For less affluent customers, the Sub-Merged Filter Company of Philadelphia sold a simple filter made of charcoal and sand that could be fitted to a water cooler or a home reservoir. The company brochure assured the public that its filters could remove all the filth from Schuylkill river water, as well as "the innumerable minute worms" that throve there.⁶¹

⁵⁹ C. L. Cohn, *The Germicide Endorsed by Science and Experience* (n.p., [1882]), pp. 4, 5, HC. Italics are in the original. In 1875, patent no. 164,842 was awarded to George Jennings for an Apparatus for Disinfecting Water Closets; no. 166,135 went to Charles F. Parker for a Disinfecting Sick Room Slop Jar; and no. 168,972 went to Henry G. Dayton for a Pocket Disinfectant and Inhaler. In 1877, patent no. 198,675 went to John H. Peterson for a Disinfecting Apparatus and Safety-Seat for Water-Closets. In 1879, patent no. 212,981 went to Abraham Rand for a Means for Ventilating Sewer-Pipes and Deodorizing the Foul Air Within. In examining the patent applications, I was struck by the number of simple disinfecting devices designed for privies, chamber pots, dry closets, and the like, which suggest that people unable to afford a flush toilet were still trying to make their toilet facilities more hygienic.

⁶⁰ Tayman's Disinfectant and Fumigating Co., *Tayman's Disinfectors and Fumigators* (Philadelphia: Privately printed, 1885), p. 4, HC. Under "Disinfectants," *Boyd's Business Directory for Philadelphia, 1879* lists two individuals in the business; in 1885, they were joined by the Reliable Disinfectant and Deodorizing Company. Tayman's company was incorporated that same year.

⁶¹ Sub-Merged Filter Company, Ltd., *A Perfect House Filter* (Philadelphia: n.p., [1885?]), p. 4, HC; Hyatt Pure Water Co., *The Hyatt System of Water Purification* (New York, n.d. [c. 1890]), HC. The Hyatt Company was based in New York City but had branches in other cities; about fifty private homes in Philadelphia are listed on pp. 50–52 of its promotional book. Brochures for the Gate City Stone Water Filter Co. of New York, and the Boston Water Purifier, can be found in the History of Medicine Division, National Library of Medicine. As in the case of ventilation, the technology of water filtration originated in the manufacturing sector and then was adapted for home use.

The inventors and promoters of these various sanitary devices frequently asserted that their prices were so low that they were "within the means of the most humble households," as Cohn said of his Germicide. In reality, the expense of devices such as the ornamental sewer gas flare, the siphon flush toilet, and the Hyatt water filtration system undoubtedly confined their use to wealthy households. However, so many domestic hygiene manuals included simple, do-it-yourself versions of sanitary devices that cost per se did not limit people's adherence to sanitary recommendations. For the conscientious homeowner determined to ventilate a room, disinfect a toilet, or install a water filter, a range of alternatives existed at different prices.⁶²

While the marketing of sanitary goods such as sewer traps and ventilators began in the 1870s, well before the germ theory gained wide public circulation, the revelations about microscopic life greatly intensified the appeal of these products. As is evident in Cohn's and Tayman's brochures for disinfection, promoters were quick to present germs as a grave new danger that made their devices even more essential to the healthy home. The prudent homeowners who had thought their work (and expense) was finished when they installed mechanical devices such as traps and ventilators now had to upgrade their sanitary protection by chemical means.

Thus in one sense, the advertising copy for sanitary goods carried on the work of the advice manuals, popularizing new information about disease prevention while at the same time promoting new sanitary goods. Yet in putting that information to frankly commercial uses, businesses often distorted it. Entrepreneurs were prone to overstate and exaggerate both the dangers posed by infection and the benefits to be derived from their particular product. Public health authorities often spoke disapprovingly of the patent gadgetry being marketed as preventives against deadly gases and germs, and emphasized that strict household discipline and inexpensive homemade devices offered equal protection. Nevertheless, the very success of the sanitarians' popular campaign ensured that they lost control of the scientific content of their message: once popular anxieties had been raised, the public was easily manipulated by commercial interests whose overriding concern was making a profit. However ineffective many of these patent devices were, though, the late nineteenth-century boom in sanitary supplies and services provides impressive testimony to the public's eagerness to purchase exemption from deadly infectious diseases.

FROM VOLUNTARY TO COMPULSORY INITIATIVES IN THE PUBLIC HEALTH MOVEMENT

The activities of municipal boards of health in the 1880s and the 1890s bear impressive testimony to the seriousness with which domestic hygiene came

⁶² Cohn, *Germicide*, [p. 17]. The only device for which I did not find a do-it-yourself version was the sewer trap. Instructions for homemade ventilators and water filters were commonplace.

to be regarded. Invoking the authority of the domestic sanitarians, public health officers took an increasingly active and coercive role in enforcing sanitary regulation of the household. Instead of being private measures that conscientious homeowners might adopt for the safety of their families, sanitary plumbing, disinfection, and water filtration gradually became duties of the state. Some of the most important regulatory goals of the late nineteenth-century public health movement can be seen, then, as the natural extension of voluntary domestic reform.

The activities of the Philadelphia Board of Health illustrate this shift from private to public initiatives. In 1885, the city adopted a building code that required homeowners to provide minimum standards of sanitary plumbing. Individuals building new homes had to file plans and specifications for their plumbing. The law provided for the board of health to inspect house drainage and register master plumbers who might perform approved work. Thereafter the great majority of prosecutions undertaken by the board of health were not for "nuisances" in public spaces such as markets and streets, but for unsanitary home plumbing. Moreover, they harassed homeowners not just for blatant infractions, such as overflowing privies, but also for more subtle errors such as unventilated drainage, defective traps, and improperly connected soil pipes. Significantly, neighbors played an active role in reporting sanitary violations to the board, suggesting that they, too, perceived such conditions as serious threats to their health.⁶³

Likewise, the board expanded the practice of compulsory quarantine and disinfection to regulate families who could not be trusted to follow the accepted procedures for the proper conduct of the "home hospital." An 1884 law provided for posting placards at homes where infectious diseases had been reported, but well into the 1890s the medical inspector was allowed "to set aside the practice in those cases where he was abundantly satisfied that the inmates of the house would faithfully carry out the printed instructions applicable to contagious diseases." This selective quarantine

⁶³ These observations are based on the Philadelphia Board of Health, Minutes of Meetings, 1888–1892, Board of Health Papers, Philadelphia City Archives, Philadelphia, Pennsylvania. The "Rules and Regulations Governing House Drainage, Ventilation and Cesspools in the City of Philadelphia . . . June 30, 1885," are tipped in the minutes for 20 October 1891. The minutes are filled with listings of the "nuisances" reported in relation to private houses. A typical entry, dated 6 October 1891, includes an unventilated drainage system; a defective connection between the house drain and the vertical soil pipe, a hopper water closet with insufficient water supply, and a defectively trapped water closet. The *Second Annual Message of Samuel H. Ashbridge, Mayor of the City of Philadelphia, with Annual Reports of . . . the Bureau of Health, for the Year ending December 31, 1900* (p. 119) gave statistical data about those who made complaints about nuisances; of approximately nineteen thousand complaints, sixteen thousand came from the public. In that report, the chief inspector of the Nuisance Division, Charles Kennedy, noted that despite improvements in the city's sanitary condition, the number of complaints continued to rise; he attributed this to "our people becoming better educated to the importance of sanitation" and looking to the board for "relief" (p. 119). For an overview of the activities of the Philadelphia Board of Health in this period, see Edward Morman, "Scientific Medicine Comes to Philadelphia: Public Health Transformed, 1854–1899" (Ph.D. diss., University of Pennsylvania, 1986). Note that by 1885, Boston, Brooklyn, and New York City had plumbing regulations similar to Philadelphia's code. They are reprinted in *Plumbing Problems* (New York: Sanitary Engineer, 1885), pp. 225–36.

policy met with such resentment that after 1895 the board began to post placards at all homes, regardless of their inhabitants' cooperation.⁶⁴ In 1885, the Philadelphia Board of Health established the post of Disinfector, and began to require the fumigation of homes where contagious diseases had been reported. Public disinfection services expanded rapidly; by 1900, the city employed six men who disinfected almost seventy-five hundred Philadelphia homes in that year alone. While most domestic disinfections were involuntary, the city also provided the service for families who requested it, thus providing at no cost what commercial disinfection companies such as Tayman's offered the more affluent.⁶⁵

Last but not least, the gradual expansion of municipal water purification capabilities made domestic filtration systems unnecessary. In response to repeated outbreaks of typhoid, Philadelphia slowly but surely began to improve its municipal sewer and water systems in the 1880s. Political factionalism and corruption dragged the process out for decades, but by 1912 the whole city had a filtered water supply. Thus, by governmental action, all citizens of early twentieth-century Philadelphia acquired the filtered water supply that affluent families had previously purchased through private water companies.⁶⁶

CONCLUSION

It is tempting to speculate, but impossible to prove, that the popularization of sanitary science, and the changes this campaign induced at the household level (e.g., improvements in home plumbing and purification of drinking water) may have contributed to the beginnings of the great mortality transition of the 1870s. What is more certain, and equally significant, is the way many late nineteenth-century public health authorities *interpreted* the falling rates of infectious disease to reinforce their long-standing belief in the importance of sanitary science and domestic hygiene.⁶⁷ The fact that the declining rates occurred more precipitously in affluent districts, where the basics of household hygiene were more firmly entrenched, only confirmed the link between individual behavior and infectious disease forged by the pioneer generation of sanitarians. Now, with a generation of middle-class voters educated in the proper hygienic principles behind them, public health authorities were able more effectively to impose those same practices on the poor, under the aegis of state medicine.

⁶⁴ City of Philadelphia, *First Annual Message of Charles F. Warwick, Mayor of Philadelphia, with Annual Reports of ... the Board of Health, for the year ending December 31, 1895*, p. 77.

⁶⁵ "Annual Report of the Division of Disinfection," in *Second Annual Message ... for 1900*, Appendix, p. 112. Morman, "Scientific Medicine," pp. 196–98, discusses the activities of the disinfection division.

⁶⁶ Michael P. McCarthy, *Typhoid and the Politics of Public Health in Nineteenth-Century Philadelphia* (Philadelphia: American Philosophical Society, 1987).

⁶⁷ For data on declining rates of infectious diseases, see Condran and Cheney, "Mortality trends in Philadelphia."

The growing power of city and state boards of health to regulate the health conditions of individual homes did not diminish the public health movement's commitment to mass health education, however. As had their nineteenth-century predecessors, the advocates of the "new public health" realized that voluntary compliance with sanitarian precepts was essential to their success. Many public health workers continued to believe that if the poor could only be taught the same hygienic practices observed in affluent homes, they too could be saved from needless suffering. Groups that had high death rates from infectious diseases such as typhoid and tuberculosis—immigrant and working-class families, and poor white and black rural families—were targeted for intensive popular health education about domestic sanitation in the early 1900s.⁶⁸

These early twentieth-century health education campaigns preserved the older sanitarian beliefs about sunshine and fresh air even as they incorporated elements of a new, bacteriologically derived hygiene.⁶⁹ In her 1906 manual on housekeeping, Maria Parloa, a founder of the home economics movement, wrote about the combined threats of damp cellars, vitiated air, and bacteria-laden carpets with no sense of contradiction.⁷⁰ Well into the 1920s, domestic manuals continued to warn against the twin dangers of sewer gas and deadly germs.

Gradually, as the benefits of sanitary plumbing, municipal sewer systems, and large-scale water purification extended to more and more Americans, and mortality rates from infectious diseases continued to decline, house diseases lost their central role in public health campaigns, to be supplanted by measures such as school health programs, mass immunization, and industrial hygiene. The lessening emphasis on domestic sanitation probably occurred first among the middle and upper classes, who by the 1920s enjoyed an unprecedented freedom from the infectious diseases that had plagued their parents and grandparents. No doubt the relief from anxiety occurred much later among poorer families, who continued both to experience higher rates of disease and to be the focus of intense educational campaigns about personal and domestic hygiene.⁷¹

⁶⁸ Naomi Rogers, "Germs with legs: flies, disease, and the new public health," *Bull. Hist. Med.*, 1989, 63: 599–617, and Richard A. Meckel, *Save the Babies: American Public Health Reform and the Prevention of Infant Mortality, 1850–1920* (Baltimore, Maryland: Johns Hopkins University Press, 1990), discuss different aspects of the mass health education crusades of the early 1900s.

⁶⁹ While there was a great deal of continuity in hygienic advice from 1870 to 1920, there were significant changes in the emphasis given certain practices, especially after tuberculosis became the chief "house disease." For example, the campaigns against spitting, common drinking cups, and flies reflect the influence of the threat of tuberculosis. I divide my study of popular hygiene into two periods, roughly 1870 to 1890, and 1890 to 1920, reflecting these changes in emphasis.

⁷⁰ Maria Parloa, *Home Economics: A Guide to Household Management* . . . , new ed. (New York: Century Co., 1906).

⁷¹ Significantly, the new time-management ethos in homemaking, which became popular in the 1910s and 1920s, was devoid of overt concern about infectious disease. The one area in which sanitary concerns remained highly visible among urban middle-class women was in the shift from bulk to packaged goods. See, for example, Christine M. Frederick, *The New Housekeeping: Efficiency Studies in Home Management* (Garden City, New York: Doubleday, Page, & Co., 1914).

The psychological ramifications of popular beliefs about the link between domestic hygiene and illness may have lingered much longer. In an era of high infant and child mortality, the domestic sanitarians forged a powerful association between guilt and responsibility for infection. The heightened intensity with which Victorian parents mourned their children, an emotional trend that is usually attributed to smaller family size and the greater value placed on the individual child, may also reflect the sanitarian educational crusade and its efforts to cultivate greater parental, and chiefly maternal, vigilance against house diseases such as diphtheria and typhoid.⁷²

Perhaps as a legacy of this painful period, the daughters of those Victorian mothers, who began child-rearing in the first and second decades of the twentieth century, ingrained in their children an obsession with germs and cleanliness born of an earlier era of domestic sanitary hazards.⁷³ To those born after the "pax antibiotica," who never experienced the "bad old days" when debility and death from infectious diseases were commonplace, such fears may seem irrational; but the AIDS epidemic has suddenly diminished the complacency of the post-World War II generation and made the threat of infection very real once again. The persistence of health beliefs acquired in childhood helps to explain why many Americans responded to the AIDS crisis with fears concerning casual modes of transmission.⁷⁴

Meanwhile, the rising concern about environmental toxins has reintroduced the notion of house diseases in a different context. Although domestic hygiene no longer figures prominently in public health campaigns against *infectious* diseases, rising cancer rates have brought about a new set of concerns about domestic pollution. Today's "killer houses" are impregnated not with dangerous bacilli but with carcinogenic substances. The public is now demanding that their homes be secured from radon gas, asbestos, toxic waste dumps, and utility lines. The nature of the threat of disease has changed radically, reflecting the new realities of life and death in a polluted world; but the drive to find protective strategies—the radon test kit, the home water filter, and the like—has haunting similarities to the efforts of late nineteenth-century families to safeguard their domestic space from infection. However irrational and ineffective individual solutions to collective health threats may seem, the "private side" of public health has a persistent appeal born of the very human need to try to control a dangerous world.

⁷² Nancy Schrom Dye and Daniel Blake Smith, "Mother love and infant death, 1750–1920," *J. Amer. Hist.*, 1986, 73: 329–53. Schrom Dye and Smith suggest that medical writings that attributed infant mortality to poor mothering were one factor that may have increased maternal guilt. On Victorian mourning customs, see Martha V. Pike and Janice G. Armstrong, *A Time to Mourn: Expressions of Grief in Nineteenth-Century America* (Stony Brook, New York: Museums at Stony Brook, 1980).

⁷³ This is an idea I heard my colleague Ruth Cowan express many years before I began this project. The personal testimonies of people in their fifties and sixties who have heard me talk on this subject strongly support this observation.

⁷⁴ I develop this argument at more length in an unpublished paper, "Popular Health Education from Tuberculosis to AIDS."