

## Deep Shit

*“Jesus may have turned water into wine, but we turn shit into food.”* The Pope of Poop

Talking about microbiomes and bacteria will not make you the life of the party. If you want to see someone change the subject real fast, start talking about the six hundred species of bacteria that reside inside your mouth. Mention that your poop is eaten by invisible beings that are everywhere, and you can prove it, and you will see whomever you’re talking to back away slowly, glancing sideways for a quick escape.

But funny things can happen on the way to the compost pile. Shortly after I published the first edition of this book, a nun called me. I had printed six hundred copies and had assumed they would decay in a storage area for the rest of my life because no one would be interested in the topic of “humanure.” But just days after the book came out, the Associated Press published an article announcing that I had written a book about crap. Then I got the phone call.

“Mr. Jenkins, we recently bought a copy of your book, *Humanure*, and we would like to have you speak at our convent.”

“What do you want me to talk about?”

“About the topic of your book.”

“Composting?”

“Yes, but specifically, *humanure* composting.” At this point I was at a loss for words. I didn’t understand why nuns would be interested in composting turds, presumably their own. I was trying to imagine standing in a room full of nuns, speaking about crap. But I kept the stammering to a minimum and accepted the invitation.

It was Earth Day, 1995. The presentation went well. After I spoke, the group showed slides of their gardens and compost piles; then we toured their compost area and poked around in the worm bins. A delightful lunch followed, during which I asked them why they were interested in composting humanure.

“We are the *Sisters of Humility*,” they responded. “The words ‘hum-

ble’ and ‘humus’ come from the same semantic root, which means ‘earth.’ We also think these words are related to the word ‘human.’ Therefore, as part of our vow of humility, we work with the earth. We make compost. And now we want to learn how to make compost from humanure. We’re thinking about buying a commercial compost toilet, but we want to learn more about the overall concepts first. That’s why we asked you to come.”

This was deep shit. Someone else is interested in harnessing the power of microorganisms to recycle their turds too. Nuns, no less. A light bulb went off in my head. Of course, composting *is* an act of humility. The people who care enough about the Earth to recycle organic material do so as an exercise in humility, whether they know it or not. They’re not going to get rich and famous for it, but its a practice that makes them better people and the Earth a better place. Humanure composters can stand under the stars at night gazing at the heavens, and know that, when nature calls, their excretions will not foul the planet. Instead, those excretions are humbly collected, fed to friendly microbes and returned to the Earth as healing medicine for the soil.

Humanity, on the other hand, seems to have strayed far from a benign symbiotic relationship with our planet and has instead taken on the visage, if not the behavior, of planetary pathogens. Yet human beings, like all other living things on this planet, are inextricably intertwined with the elements of nature. We are threads in the tapestry of life. We constantly inhale the atmosphere that envelopes the planet; we drink the fluids that flow over and under the planet’s surface; we eat the organisms that grow from the planet’s skin. From the moment an egg and a sperm unite to spark our existence, each of us grows and develops from the elements provided by the Earth and sun. In essence, the soil, air, sun, and water combine within our mother’s womb to mold another living creature. Nine months later, another human being is born.

Humans can’t comprehend the full nature of their existence, so they make up stories. Some myths assert that humans are the pinnacle of life and the entire universe was created by one of our own species.

Today, more realistic perspectives are emerging regarding the nature of human existence. The Earth itself is becoming recognized as a living entity, a level of Being immensely greater than the human level. The galaxy and universe are seen as even higher levels of Being, with multiple universes theorized as existing at a higher level yet. All these levels of Being are thought to be imbued with the energy of life, as well as with a form of consciousness that we cannot even begin to comprehend. As we humans expand the knowledge of ourselves and recognize our true place in the vast scheme of things, we must defer to reality. We must admit our absolute dependence on the ecosystem we call Earth and try to balance our feelings of self-importance with our need to live in harmony with the greater world around us. One way to harmonize with the planet is to recycle organic materials, thereby eliminating organic waste.

Asians recycled human excrement for thousands of years. The Chinese have used humanure agriculturally since the Shang Dynasty, three to four thousand years ago. The Chinese, Koreans, the Japanese, and others evolved to understand human excrement as a natural resource rather than a waste material. Where Westerners had “human waste,” they had “night soil.” We produced waste and pollution; they produced soil nutrients and food. Asians have been developing sustainable agriculture for four thousand years. For forty centuries these people worked the same land with little or no chemical fertilizers and, in many cases, had produced greater crop yields than Western farmers, who were quickly destroying the soils of their own countries through depletion and erosion.

A fact largely ignored by people in western agriculture is that agricultural land must produce a *greater* output over time. The human population is constantly increasing; available agricultural land is not. Therefore, our farming practices should leave us with land *more* fertile with each passing year, not *less* fertile.

Back in 1938 the US Department of Agriculture came to the alarming conclusion that a full 61 percent of the total area under crops in the US at that time had already been completely or partly destroyed,

or had lost most of its fertility.<sup>1</sup> Yet we're producing soil nutrients every day in the form of discarded organic materials and throwing those nutrients "away" by burying them in landfills or incinerating them.

Why didn't we follow the Asian example of agronutrient recycling? It's certainly not for a lack of information. Dr. F. H. King wrote an interesting book, published in 1910 titled *Farmers of Forty Centuries*.<sup>2</sup> Dr. King was a former chief of the Division of Soil Management of the US Department of Agriculture who traveled through Japan, Korea, and China in the early 1900s as an agricultural visitor. He was interested in finding out how people could farm the same fields for millennia without destroying their fertility. He wrote:

*One of the most remarkable agricultural practices adopted by any civilized people is the centuries long and well-nigh universal conservation and utilization of all [humanure] in China, Korea and Japan, turning it to marvelous account in the maintenance of soil fertility and in the production of food. To understand this evolution, it must be recognized that mineral fertilizers so extensively employed in modern Western agriculture have been a physical impossibility to all people alike until within very recent years. With this fact must be associated the very long unbroken life of these nations and the vast numbers their farmers have been compelled to feed.*

*When we reflect on the depleted fertility of our own older farm lands, comparatively few of which have seen a century's service, and upon the enormous quantity of mineral fertilizers which are being applied annually to them in order to secure paying yields, it becomes evident that the time is here when profound consideration should be given to the practices the [Asian] race has maintained through many centuries, which permit it to be said of China that one-sixth of an acre of good land is ample for the maintenance of one person, and which are feeding an average of three people per acre of farm land in the three southernmost islands of Japan.*

*[Western humanity] is the most extravagant accelerator of waste the world has ever endured. His withering blight has fallen upon every living thing within his reach, himself not excepted; and his besom of destruction in the uncontrolled hands of a generation has swept into the sea soil fertility*

*which only centuries of life could accumulate, and yet this fertility is the substratum of all that is living.*<sup>3</sup>

According to King's research, the average daily excreta of the adult human weighs in at 40 ounces (2.5 pounds), or 825 million pounds of humanure every day, day in and day out, produced and wasted in the US alone. Other researchers estimate that humanure contains about 11 pounds per person per year of agricultural nutrients nitrogen, phosphorus, and potassium (N, P, and K). Multiplied by 330 million, a rough estimate of the US population in the early twenty-first century, Americans each year produce 3.63 billion pounds of valuable agricultural nutrients<sup>4</sup> just by relieving themselves in a toilet. Almost all of it is discarded into the environment as a waste material or a pollutant, or as Dr. King puts it, "poured into the seas, lakes or rivers and into the underground waters."

According to King, *The International Concession of the city of Shanghai, in 1908, sold to a Chinese contractor the privilege of entering residences and public places early in the morning of each day and removing the night soil, receiving therefore more than \$31,000 gold, for 78,000 tons of [humanure]. All of this we not only throw away but expend much larger sums in doing so.*<sup>5</sup>

In case you didn't catch that, the contractor *paid* \$31,000 gold for the humanure, referred to as "night soil" and incorrectly as "waste" by Dr. King. People don't pay to buy waste; they pay money for things of value. Furthermore, using Dr. King's figures, the US population produced over three hundred billion pounds of fecal material annually in the early twenty-first century. That's a lot of *gross* national product.

Admittedly, the spreading of raw human excrement on fields, as may be done in Asia, will never become culturally acceptable in the United States, and rightly so. The agricultural use of raw night soil produces an assault on the sense of smell and provides a route of transmission for various human disease organisms. Americans who have traveled abroad and witnessed the use of raw human excrement in agricultural applications have largely been repulsed by the experience.

That repulsion has instilled in many older Americans an intransigent bias against, and even a fear of, the use of humanure for soil enrichment. However, few Americans have witnessed the composting of humanure as a preliminary step in its recycling. Proper composting converts humanure into a pleasant-smelling material devoid of human pathogens.

Although the agricultural use of raw human excrement will never become a common practice in the US, the use of composted human refuse, including humanure, food scraps, and other discarded organic materials can and should become a widespread and culturally encouraged practice.

How is it that Asian peoples developed an understanding of human nutrient recycling centuries ago, and we didn't? After all, we're the advanced, developed, scientific nation, aren't we? Dr. King makes an interesting observation concerning Western scientists. He states:

*It was not until 1888, and then after a prolonged war of more than thirty years, generated by the best scientists of all Europe, that it was finally conceded as demonstrated that leguminous plants acting as hosts for lower organisms living on their roots are largely responsible for the maintenance of soil nitrogen, drawing it directly from the air to which it is returned through the processes of decay. But centuries of practice had taught the Far East farmers that the culture and use of these crops are essential to enduring fertility, and so in each of the three countries the growing of legumes in rotation with other crops very extensively, for the express purpose of fertilizing the soil, is one of their old fixed practices.<sup>6</sup>*

It certainly seems odd that people who gain their knowledge in real life through practice and experience are sometimes largely ignored or trivialized by the academic world and associated government agencies. Such agencies may only credit learning that has taken place within an institutional framework. It's no wonder that Western humanity's crawl toward a sustainable existence on planet Earth seems so slow.

*Strange as it may seem, says King, there are not today [early 1900s] and apparently never have been, even in the largest and oldest cities of Japan, China, or Korea, anything corresponding to the hydraulic systems of sewage disposal used now by Western nations. When I asked my interpreter if it was not the custom of the city during the winter months to discharge its night soil into the sea, as a quicker and cheaper mode of disposal [than recycling], his reply came quick and sharp, “No, that would be waste. We throw nothing away. It is worth too much money.”<sup>7</sup> The Chinaman, says King, wastes nothing while the sacred duty of agriculture is uppermost in his mind.<sup>8</sup>*

While the Asians were practicing sustainable agriculture and recycling their organic resources and doing so over millennia, what were the people of the West doing? Why weren't our European ancestors returning their manures to the soil, too? After all, it does make sense. The Asians who recycled their manures not only utilized a resource and reduced pollution, but by returning their excrement to the soil, they succeeded in reducing threats to their health. There was no putrid sewage collecting and breeding disease germs and attracting rats. Instead, the humanure was, for the most part, undergoing a natural, non-chemical purification process in the soil. Even the returning of humanure raw to the land succeeds in destroying many human pathogens in the manure and returns nutrients to the soil.

What was happening in Europe regarding public hygiene from the 1300s on? Great pestilences swept through Europe throughout recorded history. The Black Death killed more than half the population of England in the fourteenth century. In 1552, sixty-seven thousand patients died of the plague in Paris alone. Fleas from infected rats were the carriers of this disease. Did the rats dine on piles of human waste or festering garbage? Other pestilences included the sweating sickness (attributed to uncleanness), cholera (spread by food and water contaminated by the excrement of infected persons), “jail fever” (caused by a lack of sanitation in prisons), typhoid fever (spread by water contaminated with infected feces), and numerous others.

Andrew White, cofounder of Cornell University, wrote, *Nearly twenty centuries since the rise of Christianity, and down to a period within*

*living memory, at the appearance of any pestilence, the Church authorities, instead of devising sanitary measures, have very generally preached the necessity of immediate atonement for offenses against the Almighty. In the principal towns of Europe, as well as in the country at large, down to a recent period, the most ordinary sanitary precautions were neglected, and pestilences continued to be attributed to the wrath of God or the malice of Satan.*<sup>9</sup>

It's now known that the main cause of such immense sacrifice of life was a lack of proper hygienic practices. It's argued that certain theological reasoning at that time resisted the evolution of proper hygiene. According to White, "For century after century the idea prevailed that filthiness was akin to holiness." Living in filth was regarded by holy men as evidence of sanctity, according to White, who lists numerous saints who never bathed parts or all of their bodies, such as St. Abraham, who washed neither his hands nor his feet for fifty years, or St. Sylvia, who never washed any part of her body except her fingers.<sup>10</sup>

Interestingly, after the Black Death left its grim wake across Europe, "an immensely increased proportion of the landed and personal property of every European country was in the hands of the church."<sup>11</sup> Apparently, the church was reaping some benefit from the deaths of huge numbers of people. Perhaps the church had a vested interest in maintaining public ignorance about the sources of disease. This insinuation is almost too diabolical for serious consideration. Or is it?

Somehow, the idea developed around the 1400s that Jews and witches were causing the pestilences. Jews were suspected because they didn't succumb to the pestilences as readily as the Christian population did, presumably because they employed a unique sanitation system more conducive to cleanliness, including the eating of kosher foods. The Christian population nevertheless concluded that the Jews' immunity resulted from protection by "Satan." As a result, attempts were made in all parts of Europe to stop the plagues by torturing and murdering the Jews. Twelve thousand Jews were reportedly burned to death in Bavaria alone during the time of the plague, and additionally thousands more were killed throughout Europe.<sup>12</sup>

In 1484 the "infallible" Pope Innocent VIII issued a proclamation

supporting the church's opinion that witches were causes of disease, storms, and a variety of ills affecting humanity. The feeling of the church was summed up in one sentence: "Thou shalt not suffer a witch to live." From the middle of the sixteenth to the middle of the seventeenth centuries, both women and men were sent to torture and death by the thousands by both Protestant and Catholic authorities. It's estimated that the number of victims sacrificed during that century in Germany alone was over a hundred thousand.

The following case in Milan, Italy, summarizes the ideas of sanitation in Europe during the seventeenth century: The city was under the control of Spain, and it had received notice from the Spanish government that witches were suspected to be en route to Milan to "anoint the walls" (smear the walls with disease-causing ointments). The church rang the alarm from the pulpit, putting the population on the alert. One morning in 1630, an old woman looking out her window saw a man who was walking along the street wipe his fingers on a wall. He was promptly reported to the authorities. He claimed he was simply wiping ink from his fingers that had rubbed off the ink-horn he carried with him. Not satisfied with this explanation, the authorities threw the man into prison and tortured him until he "confessed." The torture continued until the man gave the names of his "accomplices," who were subsequently rounded up and tortured. They in turn named their "accomplices" and the process continued until members of the foremost families were included in the charges. Finally, a large number of innocent people were sentenced to their deaths.<sup>13</sup>

One loathsome disease of the 1500s through the 1700s was the "jail fever." The prisons of that period were filthy. People were confined in dungeons connected to sewers with little ventilation or drainage. Prisoners incubated the disease and spread it to the public, especially to the police, lawyers, and judges. In 1750, for example, the disease killed two judges, the lord mayor, various aldermen and many others in London, including of course, prisoners.<sup>14</sup>

The pestilences in the Protestant colonies in America were also attributed to divine wrath or satanic malice, but when the diseases af-

flicted the Native Americans, they were considered beneficial. “The pestilence among the Indians, before the arrival of the Plymouth Colony, was attributed in a notable work of that period to the Divine purpose of clearing New England for the heralds of the gospel.”<sup>15</sup>

Perhaps the reason the Asian countries have such large populations in comparison to Western countries is that they escaped some of the pestilences common to Europe, especially pestilences spread by the failure to responsibly recycle human excrement. They plowed their manure back into the land, while Westerners were busy burning witches and Jews with the church’s wholehearted assistance.

Our ancestors did, eventually, come to understand that poor hygiene was a causal factor in epidemic diseases. Nevertheless, it was not until the late 1800s in England that improper sanitation and sewage were suspected as causes. At that time, large numbers of people were still dying from pestilences, especially cholera, which killed at least 130,000 people in England in 1848-49 alone. In 1849 Dr. Snow published his theory that cholera was spread by water contaminated with sewage. Yet, even where sewage was being piped away from the population, the sewers were still contaminating drinking water supplies.

The English government couldn’t be bothered with the fact that hundreds of thousands of mostly poor citizens were perishing like flies year after year. So it rejected a public health bill in 1847. A bill finally became an act in 1848 in the face of the latest outbreak but wasn’t terribly effective. However, it did bring poor sanitation to the attention of the public, as the following statement from the General Board of Health in 1849 implies: *Householders of all classes should be warned that their first means of safety lies in the removal of dung heaps and solid and liquid filth of every description from beneath or about their houses and premises.* This makes one wonder if a compost pile would have been considered a “dung heap” in those days, and therefore banned.

Sanitation in England was so bad in the mid-to-late 1800s that, *in 1858, when the Queen and Prince Albert had attempted a short pleasure cruise on the Thames, its malodorous waters drove them back to land within a few minutes. That summer a prolonged wave of heat and drought exposed its*

*banks, rotten with the sewage of an overgrown, undrained city. Because of the stench, Parliament had to rise early.* Another story describes Queen Victoria gazing out over the river and asking aloud what the pieces of paper were that so abundantly floated by. Her companion, not wanting to admit that the Queen was looking at used toilet paper, replied, *those, Ma'am, are notices that bathing is forbidden.*<sup>16</sup>

The Tories or “conservatives” of the English government still thought that spending on social services was a waste of money and an unacceptable infringement by the government on the private sector (sound familiar?). A leading newspaper, the *Times*, maintained that the risk of cholera was preferable to being bullied by the government into providing sewage services. However, a major act was finally passed in 1866, the Public Health Act, with only grudging support from the Tories. Once again, cholera was raging through the population, and it’s probably for that reason that any act was passed at all. Finally, by the end of the 1860s, a framework of public health policy was established in England. Thankfully, the cholera epidemic of 1866 was the last and the least disastrous.<sup>17</sup>

The powers of the church eventually diminished enough for scientists and physicians to have their much-delayed say about the origins of disease. Our modern sanitation systems have finally yielded a life safe for most of us, although not without shortcomings. The eventual solution developed by the West was to collect human excrement in our drinking water supplies, then discard the polluted water, perhaps first attempting to remove the excrement — chemically treated, incinerated, or dehydrated — then releasing the finished product into the seas, into the atmosphere, onto the surface of the land, and into landfills.

Today, Asians are abandoning the harmonious agricultural techniques that Dr. King observed nearly a century ago. In Kyoto, Japan, for example, “night soil is collected hygienically to the satisfaction of users of the system, only to be diluted at a central collection point for discharge to the sewer system and treatment at a conventional sewage treatment plant.”<sup>18</sup>

*A Humanure Handbook* reader wrote an interesting account of

Japanese toilets in a letter to the author, which is paraphrased here:

*My only real [humanure] experience.... comes from living in Japan from 1973-1983. As my experience is dated, things may have changed (probably for the worse as toilets and life were becoming “westernized” even toward the end of my stay in Japan).*

*My experience comes from living in small, rural towns as well as in metropolitan areas (provincial capitals). Homes and businesses had an “indoor outhouse.” The Vault: Nothing but urine/feces were deposited into the large metal vault under the toilet (squat style, slightly recessed in the floor and made of porcelain). No cover material or carbonaceous stuff was used. It stunk!! Not just the bathroom, but the whole house! There were many flies, even though the windows were screened. Maggots were the main problem. They crawled up the sides of the vault onto the toilet and floor and sometimes even made it outside the bathroom into the hall. People constantly poured some kind of toxic chemical into the vaults to control the smell and maggots. It didn’t help — in fact, the maggots really poured out of the vault to escape the chemicals. Occasionally a slipper (one put on special “bathroom slippers” as opposed to “house slippers” when entering the bathroom) fell into the disgusting maggot-filled vault. You couldn’t even begin to think about getting it out! You couldn’t let little children use the toilet without an adult suspending them over it. They might fall in! Disposal: When the vault was full (about every three months), you called a private vacuum truck which used a large hose placed in an outside opening to suck out the liquid mass. You paid them for their services. I’m not sure exactly what happened to the humanure next but, in the agricultural areas near the fields were large (ten feet in diameter) round, concrete, raised containers, similar in looks to an above ground swimming pool. In the containers, I was told, was the humanure from the “vacuum trucks.” It was a greenish-brown liquid with algae growing on the surface. I was told this was spread onto agricultural fields.*

In 1952 about 70 percent of Chinese humanure was recycled. This had increased to 90 percent by 1956 and constituted a third of all fertilizer used in the country.<sup>19</sup> Lately, however, humanure recycling in China is going down the drain. The use of synthetic fertilizers rose over 600 percent between the mid-1960s and the mid-1980s. Between 1949 and 1983, agricultural nitrogen and phosphorous inputs increased by a factor of ten, while agricultural yields only tripled.<sup>20</sup> Chinese farmers now use an average of 270 pounds of nitrogen per acre per year — more than four times the global average. Asia’s fertilizer consumption has grown faster than that of any other part of the world.<sup>21</sup>

The high usage of nitrogen fertilizer in China is now contributing to widespread environmental problems such as deteriorating water quality, soil acidification, greenhouse gas emissions, and disruption of the global nitrogen cycle. China’s first national pollution survey in 2010 identified agriculture as a major polluter.<sup>22</sup>

China was producing over 3.5 million tons of sewage waste per day by 2008. It is estimated that six hundred million Chinese now drink water contaminated by human or animal waste.<sup>23</sup> Surface water monitored at over twelve thousand sites across China revealed that one out of five water sources was not suitable for human *contact*, and 13 percent were too polluted to be used for *anything*. In Shanghai, one of China’s most modern cities, fifty-two out of sixty-five monitoring sites had water not suitable for human contact, according to a 2017 report.<sup>24</sup> Eighty-five percent of the water in Shanghai’s rivers was undrinkable by 2015, and over 56 percent was unfit for any purpose. In Beijing, almost 40 percent of its water was so polluted that it couldn’t be used for anything either. In Tianjin, a northern Chinese city of fifteen million people, less than 5 percent of the water can be used for drinking. In 2015, 3.78 billion cubic meters of untreated wastewater were discharged across China, including 1.98 million cubic meters in Beijing alone. This is water that is not usable for agricultural, industrial, or even decorative purposes, dumped into rivers and lakes.<sup>25</sup>

It is estimated that nearly five hundred thousand tons of humanure are dumped into the Huangpu River alone in a year. Half a million

cases of hepatitis A, spread by polluted water, occurred in Shanghai in 1988. *“Increasingly, Chinese urban authorities are turning to incineration or landfill as the ways of disposing of their solid wastes rather than recycling and composting, which means that China, like the west, is putting the problem onto the shoulders of future generations.”*<sup>26</sup>

But let’s not pick on China. India also has massive water pollution problems as do many other places around the world. India’s 855-mile-long Yamuna River, which flows through Delhi, is said to be a river of “foul sludge,” polluted with industrial chemicals, floating plastic, and “human waste” (actually all these things are “human waste”). In 2017 the river contained 22 million fecal coliforms of bacteria per 100 ml of water (3.3 ounces). By comparison, in Vermont, if water has only 235 fecal coliforms in 100 ml it is considered too polluted for bathing.<sup>27</sup>

India generates close to two million tons of human excrement every day, and although 80 per cent of household wastewater leaves homes as sewage, approximately 80 to 90 percent of it is untreated.<sup>28</sup> Nearly ten billion gallons of sewage flow into rivers in India every day,<sup>29</sup> making untreated sewage the leading source of water pollution and causing the deaths of 350,000 Indian children every year due to diarrhea.<sup>30</sup>

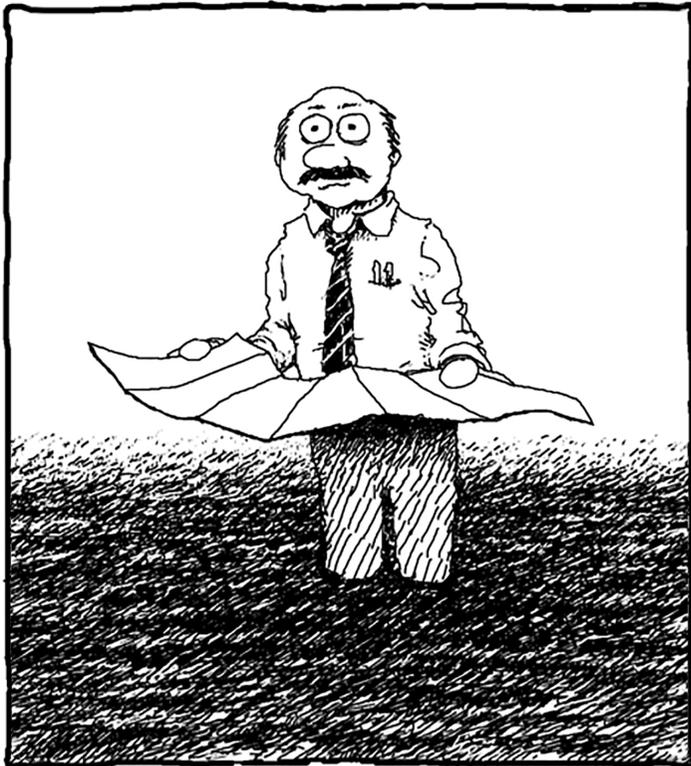
And what about the US? Wastewater treatment facilities in the United States process approximately thirty-four billion gallons of wastewater every day.<sup>31</sup> Still, 3.5 million Americans get sick every year after swimming, boating, fishing, or even touching water polluted with “human waste,” household chemicals, personal hygiene products, pharmaceuticals, and whatever else is dumped down our drains.

Each year more than 860 billion gallons of polluted water escape American sewers — enough to flood the entire state of Pennsylvania up to your ankles.<sup>32</sup> According to the EPA, twenty-three thousand to seventy-five thousand sanitary-sewer overflows happen annually in America, and three to ten billion gallons of untreated wastewater are released into the environment.<sup>33</sup>

Do your kids ever get a stomach flu? It could be the rain. Researchers have found an 11 percent increase in American kids going to a doctor with acute gastrointestinal illness four days after a heavy

rainfall, largely due to fecal contaminants such as bacteria, protozoa, and viruses from sewage infiltrating water pipes and polluting local waterways.<sup>34</sup>

A 2012 paper about the value of humanure in the African nation of Niger showed that the average excreta production per family per year is equivalent to approximately two hundred pounds of chemical fertilizer.<sup>35</sup> They can't afford to buy this amount of fertilizer, but they produce it themselves by natural processes and don't even realize it. How does one convert excrement back into food? What's the process? Is it safe? The answer, in a word, is *composting*. But first, let's look at what usually happens to Mr. Turdly on any given day in the US.



Every year, billions of gallons of polluted water escape American sewers — enough to flood the entire state of Pennsylvania up to your ankles. We need more than a road map to find our way out of this situation.

