

our immune system and finding new ways to prevent or exploit inflammatory responses designed to promote their elimination. Even bacteria traditionally viewed as “commensal” may change their behavior in ways that promote their survival to our detriment, particularly in combination with host genetic predispositions and environmental pressures in the form of, for example, sanitation, vaccination, and antibiotic use. It is also well to remember the prescient admonition of Louis Pasteur: “*C’est les microbes qui auront le dernier mot*” (the microbes will have the last word).

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Book review: *The Big Necessity*



The Big Necessity: The Unmentionable World of Human Waste and Why It Matters Rose George

Metropolitan Books, New York, 2008 (304 pp)

Lars Hanson’s career in mucosal immunology has bridged his basic research characterizing secretory immunoglobulin A in human milk to the importance of breast-feeding for the improvement of human health. His advocacy provided scientific merit that helped redirect federal budgets in Costa Rica toward maternal-infant health, leading to dramatic reductions in infant mortality.¹

In this book, Rose George describes global deficiencies in sanitation and does a favor for basic research by reminding readers of the social relevance of mucosal immunology. In a well-researched and referenced social commentary, she notes that 40% of humanity—2.6 billion people—have no alternative to open defecation. That means “no access to any latrine, toilet, bucket or box,” just “bare bottoms doing what they must.” The estimated tonnage in raw sewage is numbing (200,000 tons every day in India alone). The author points out that the vastness of the enteric microbiome causes numerous mucosal diseases when sewage is not handled properly: “Feces can get into fluid and onto

fields, fingers, flies, and foods.” The impact of contamination is reflected in the Bangladeshi slogan “A fly is deadlier than a thousand tigers.” She notes that diarrhea “kills a child every 15 seconds”—more than 2.2 million per year. Clearly, there are limits to any protection attributable to the hygiene hypothesis.

George visits a range of strategies to protect people from contaminated water, including John Snow’s removal of London’s Broad Street pump handle to stem a cholera outbreak. She toured the world’s grand sewers and observed open defecation in the worst slums imaginable. She interviewed politicians, functionaries, engineers, sewer workers, and defecators from China, Bangladesh, and India, as well as Europe and the United States. No relevant issue is left unexplored, including the economic, social, and cultural pressures that lead to the acceptance of or resistance to change.

The discussion carries on with great humor (she cites a joke told in Moscow: “How do you use a latrine in a Russian winter? Quickly.”) and candor as George provides details that only someone interested in gastroenterology might appreciate. To say the text is indelicate is an understatement, but she points out that disgust is an effective motivation that encourages people to contain waste. Despite the existence of many euphemisms for excrement, the author observes that the absence of a conversational term contributes to the lack of meaningful discussion. She notes that the Greek word *skihzein*, the Latin *scindere*, and the Old English *scitan* are the noble relatives of “shit.” The term is used throughout the book and, as she writes, “people who deal with things best are the ones not afraid of it.”

While the infrastructure in wealthier countries is better, the author points out that many of our large cities allow sewage to run untreated into major waterways. As a result of shortcomings in infrastructure, rain runoff is mixed with sewage, forcing the discharge of untreated waste. This, along with agricultural runoff, causes outbreaks of diarrhea and death, even in the United States and Canada. Mucosal vaccines for foodborne illnesses and biodefense remain a huge need in our own health-care systems.

After spending nearly 30 years editing manuscripts and grant applications critically, I may be too sensitive to editorial errors, but a few exist that lead the reader to be wary of some of the statistics presented. Nonetheless, the case George makes is compelling.

The relevance of the book to those of us in the field of mucosal immunology is clear, as mucosal immunologists can have a positive impact in many areas. The biggest challenge may be the unchecked expansion of the global population. Mucosal vaccines targeted to the urogenital tract may yet be developed for birth control as well as for protection from sexually transmitted diseases, potentially reducing the devastating toll of HIV infection. Similarly, infections of the airway can be controlled through better sanitation as a complement to new mucosal vaccines.

Bathing in contaminated water and aerosol exposures can cause infections of the

urogenital tract and airway, but enteric infection accounts for the overwhelming share of the health-care burden. As we are reminded in this book, “No act of terrorism generates economic devastation on the scale of the crisis in water and sanitation.” In addition to the mortality, enteric infections cause substantial morbidity associated with frequent outbreaks of diarrhea. Increasingly, malnutrition is viewed as an enteric, infectious disease that leads to stunted growth and impaired cognitive development.² Mucosal vaccines for enteric infections may not work optimally without improvements in sanitation, because the overwhelming number of recurrent challenges may thwart the most innovative immunization protocols and limit herd immunity.

After reading this book, most people will wash their hands a little longer and think a little more before they flush. Given that many of us will never travel to these poorer

countries, George’s impassioned descriptions will give readers a better appreciation of the challenges. A mucosal immunologist will be even more inspired by the urgency for vaccine development. From Lars Hanson’s perspective, this book describes issues that support advocacy by both scientists and nonscientists for greater funding of sanitation in order to reduce the infectious burden enough to allow new vaccines to succeed.

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