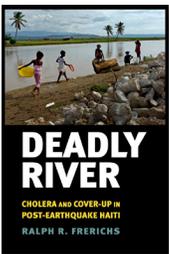


DEADLY RIVER: CHOLERA AND COVER-UP IN POST-EARTHQUAKE HAITI



By Ralph R. Frerichs

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Review by: Tom Koch, University of British Columbia

Ralph Frerichs's *Deadly River* is, in no small part, an object lesson on the manner in which maps make sense of chaos in the midst of complex world events. A retired professor of epidemiology and public health, Frerichs's focus, and indeed his passion, lies with the microbial world and its periodic attacks on humankind.

Deadly River is the story of the worst cholera epidemic in recent history. It began in 2010 near Mirebalais in Haiti's interior, soon after the island was devastated by a magnitude 7.0 earthquake. That earthquake killed an estimated 300,000 people and left an estimated 3 million citizens, most of them desperately poor, without clean water, decent shelter, or food. By 2016, the epidemic had killed at least 10,000 Haitians and sickened an estimated 800,000 more who eventually recovered.

Frerichs's book is, at its simplest level, the story of how epidemiologists and public health officials struggled to understand and then combat the killer epidemic. It is secondarily a tale of obfuscation and a possible cover-up attempt by United Nations and World Health Organization officials who did not want to admit that the source of the

epidemic might be United Nations Nepalese peacekeepers on mission in the island state.

This is also a heroic tale whose focus is the work of a French epidemiologist, Dr. Renaud Piarroux, who was invited by the Haitian government to investigate the epidemic soon after it began. In the telling Frerichs goes from being an interested and informed observer following the epidemic's course to a partisan supporter of, and eventually coauthor with, Piarroux.

MAPS

The story of Piarroux's investigation, and of the debate over the origins of this outbreak, is a story best told in maps. "On the day after cholera was officially reported in the country," Frerichs writes, "the first of many disease maps was published in an Emergency Operations Center (EOC) report by the Haitian Ministry of Public Health and Population, in collaboration with PAHO [Pan American Health Organization]" (68). From the start, and as updates became available, Piarroux made screen shots of those maps, mostly at the departmental (district) level, and carried them with him during his field work.

With that, Frerichs introduces maps as the invaluable assistants with which questions about the origin and spread of a disease are to be addressed. "Maps are closely entwined with epidemiology. They allow disease detectives to view illness or death patterns in space and time, showing gradual—or sometimes explosive—spread through a community, country, or even the world" (67). The entire book can be read as an argument for the map as an investigative tool that best explains complex outcomes in terms of their constituent parts. Again and again, the author refers to this or that map at one or another point in the story as not merely illustrative, or even persuasive, but as critical where not absolutely conclusive. At the least, maps were not only invaluable in the field but also as a way for Piarroux to present his findings to Haitian and international officials.

"It was with cholera maps," writes Frerichs, "that Piarroux was most persuasive. He had developed maps showing cholera mortality for each of Haiti's 140 communes. He first had used these maps in a presentation to President Préval and Health Minister Larson. He then used them at *Unité de Crise* meetings with representatives from WHO

(World Health Organization), UNICEF, and the NGOs (non-governmental organizations) and to brief the Cuban Ambassador at [Haitian President] Préval's request and members of the *Brigada Médica Cubana*" (109). In this official, tri-lingual mélange of English, Spanish, and French, maps were a lingua franca amongst the parties engaged in combating and investigating the outbreak.

While medical cartographers and geographers will find *Deadly River* a useful introduction to the complexities of epidemic fieldwork, the general reader may feel that the story needs some narrative tension, and perhaps a villain. In this book it is the debate over the source of the epidemic, and responsibility for it, that provides the drama. The main villains are those who advanced origin theories that differed from Piarroux's.

"Most hypotheses put forward for how *Vibrio cholerae* had arrived in the country were in one of two categories: environmental or human activity—long points of contention among the world's cholera investigators" (58). Environmentalists argued the disease might have been dormant for years in Haitian waters and its estuarine zones until somehow activated by the earthquake that preceded it. Others suggested that perhaps an ocean vessel bringing relief supplies (or simply transporting goods) had dumped contaminated bilge water off the Haitian shore and thus introduced cholera to local waters.

To Piarroux, however, the origin was obviously a massive discharge of contaminated human waste into the Artibonite River from the Nepalese peacekeeper barracks just up-river from the first cholera cases. The course of the disease, and its origins, could be read in the maps of the epidemic's progress.

In a real way, the Haitian epidemic thus replayed nineteenth century debates over the nature of the disease. Environmentalists of that time assumed cholera was a "natural," presumably airborne, disease. To prevent it would be, as one said, like stopping the wind. British physician John Snow, among others, insisted its origin and diffusion were anthropogenic. To make that case Snow famously mapped a cholera outbreak in his London neighborhood of Soho, and then, more ambitiously, a concurrent epidemic across South London. The story of his mapped arguments became the stuff of legend, a kind of origin myth for medical geographers and the methodology of modern public health (Koch 2016).

Frerichs is an ardent admirer of John Snow and has long maintained a website dedicated to his work (Frerichs 2017). Here was another cholera epidemic in which mapping seemed to provide crucial evidence permitting one theory of disease incidence to triumph over another. In both cases, one from the nineteenth century and the other from the twenty-first, maps were crucial evidentiary tools.

Reference to Snow is, in part, a way to introduce basic epidemiological methodologies and ideas, but the parallels are easily overstated. In the mid-nineteenth century the nature of cholera was unclear (was it airborne or waterborne?) and the methods of its investigation were evolving (Koch 2000). These methods weren't at issue in 2010. Then, too, while Snow did not succeed in convincing his contemporaries that the source of both local outbreaks and broader epidemics were local water sources, Piarroux successfully argued, on the basis of modern scientific techniques as well as cartographic evidence, his explanation about the origin of this epidemic.

Figure 1 is a map provided by Frerichs from a paper he coauthored in 2012 with Piarroux. It shows the progress of the disease from the Nepalese encampment near Mirebalais down the river. This map sequence is the end point of the study. It incorporates data from earlier fieldwork in which cholera incidence was mapped, district by district and town by town.

What Piarroux proved beyond any reasonable doubt was that the origin of the outbreak was proximate to the Nepalese peacekeeper's camp on the Artibonite River near Mirebalais. There was evidence—*anecdotal but compelling*—that sewage from the camp was spilled into the river, perhaps by a negligent local contractor, creating a toxic plume that infected downriver villages as it traveled to the sea. The disease could not have originated in coastal waters, traveling inland from there, because the rivers flow *into* the ocean, not away from it; even were the disease dormant in Haitian estuaries, it progressed downstream, *away from* the neighborhood of Mirebalais, rather than against the current, *towards* it.

A definitive element of the argument was the serology that eventually categorized the active bacterium as a specific Nepalese strain. The environmentalists were correct that varieties of cholera bacterium (and there are many: it's a family, not a single entity) may live in local waters for

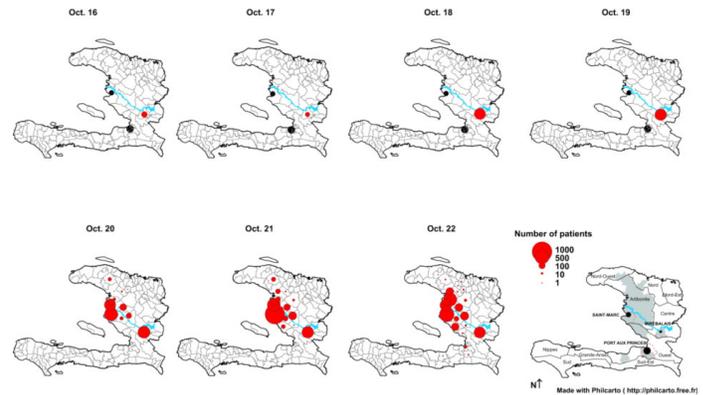


Figure 1. This map, from a paper by Frerichs and Piarroux (Frerichs et al. 2012), describes the spread of cholera along the Artibonite River, marked here in blue, from the Nepalese encampment near Mirebalais (used with author's permission).

years. Most don't cause illness, however, and genetic analysis proved this specific and virulent cholera variant was indisputably Nepalese. The progress of the disease could *only* be explained by a massive discharge of waste from the Nepalese camp that progressed in a plume down the Artibonite River.

From the start, UN and WHO officials insisted this couldn't be true. Nepalese soldiers weren't sick. They insisted camp sewage was properly disposed of and local sewage facilities were adequate. Local informants, however, suggested a waste truck may have emptied sewage tanks and simply dumped the waste in the river. What was clear from Piarroux's work was this: the camp was near the river; the progress of the epidemic was down river; villages along the river used its water for cooking, bathing, and washing; there were sewage leaks; and no other likely source of this epidemic could be proven. Only the plume from a massive spill into the river from the Nepalese peacekeepers' site would explain the cholera that killed so many Haitians in the months following the earthquake.

The results were widely consequential. Knowing the source of an outbreak permits health officials to predict its course and prepare for the care of those who will be infected. Knowing who is sick, and where, is a critical element of all disaster relief plans. As a National Research Council publication on disaster preparedness put it: *Successful Response Starts with a Map* (Committee on Planning for Catastrophe 2007). And, too, knowing the origin of an epidemic may both help limit its progress and prevent recurrences.

The cholera introduced in 2010 remains an ongoing health problem today. It took years for the United Nations to admit even qualified responsibility for the Haitian cholera epidemic. Having done so, officials have refused calls for compensation for the epidemic's victims. But then, as we learned during the West African Ebola epidemic in 2014, WHO—the United Nations' health agency—has been continually strapped for funds and its resources repeatedly pruned through years of budget cuts.

Here the problem was complicated by the fact that the source of the epidemic was a group of UN peacekeepers, dispatched to the island for humanitarian service after the earthquake. Investigation of their apparent culpability revealed, over time, broader problems with UN peacekeeping sites. In 2016, United Nations auditors reported that “poor sanitation practices remained unaddressed not only in its Haitian mission but also in at least six others in Africa and the Middle East” (Gladstone 2016). Haiti became an example of what happens when the best of peacekeeper intentions are undermined by basic infrastructure failures. As Frerichs implies in his writing on Snow and cholera, then and now, the Haitian epidemic echoes the nineteenth century understanding of sanitation infrastructure as a crucial barrier to disease transmission.

COMPLAINTS

Frerichs's authorial style is academic, and while that suits a part of his story, it doesn't quite contain the political and social messages he seeks to convey. As a result, there is a tension in the writing between the nuts-and-bolts story of the investigation and his outrage at the obfuscation of the environmentalists and of the United Nations officials who did not want to admit responsibility.

It is unfortunate that the text refers to, but does not include, most of the plethora of maps that were distributed by WHO, PAHO, and the US Centers for Disease Control and Prevention during the epidemic. Nor do we see those created by Piarroux and presented in his discussions with Haitian and other international agency officials involved in combating this outbreak. Worse, the few maps that are included are of uniformly low quality and in some cases barely legible. It should be noted that the illustration accompanying this review is *not* from *Deadly River*, but from a different paper by Frerichs and Piarroux.

While the quality of the maps in this book is lamentable, the author has, “independent of the publisher” (xi), provided web-based resources where some of the maps and other images central to the book's theme can be found: www.deadlyriver.com, and, more specifically, www.deadlyriver.com/mmmaps.html (*note the double m*). The first is a general website for the book, and the second is a collection of bi-annual maps of UN camps in Haiti, 2004–present, with UN Security Council reports of Haitian activity.

Frerichs's repeated references to John Snow and the history of mid-nineteenth century cholera debates does resonate at some level here, but, again, it is easily overstated. There were, as I have argued elsewhere (Koch and Denike 2009), good reasons for Snow's contemporaries to question his findings, but there is no doubt, in this reading, that in Haiti environmental explanations did not serve and that Piarroux was correct. That said, the story of how critics, then and now, disputed the evidence of field epidemiologists and their evidentiary maps joins the nineteenth- and twenty-first-century stories.

Frerichs's narrative could have been effectively broadened with the introduction of some more general contextual material. The British geographer Peter Haggett has produced many books—for example, *The Geographical Structure of Epidemics* (Haggett 2000)—that would have served as useful models. Haggett is a master of making the technical seem simple and demonstrating the means by which maps and statistics together can uncover an epidemic's secrets.

This is not a great book. It is, however, a very useful one. The story it tells is important, and in the epidemiological unfolding of a disease study Frerichs is an old hand, a professional. Too, *Deadly River* is a reminder that even “scientific” work occurs within contexts that are at once political and social; to ignore that is to miss the greater story. And, of course, here is a book in which maps are a tool of choice successfully deployed by heroic researchers. For cartographers, the book sets modern disease events in a spatial frame they will appreciate, and, too, it might encourage some to develop the necessary expertise to apply their mapping to disease studies.

In an era of rapidly evolving infectious diseases, that end would serve us all.

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