HEALTH, DISEASE, AND ENVIRONMENTAL HISTORY

James L. A. Webb, Jr.
Department of History, Colby College, 5328 Mayflower Hill Drive, Waterville, Maine 04901 USA

Keywords: agricultural revolution, Columbian Exchange, infectious disease, epidemic, epidemiological transition, epidemiological gradient, global public health, global warming, health transition, industrialization of agriculture, population growth, rural-urban migration, sanitation, urbanization.

Contents

Summary

This essay provides an overview of the major forces that have transformed the relationships between human health, disease, and the environments in which we live, from Paleolithic times to the present.

Our earliest environmental initiatives gave us critical control over our environments: we mastered the use of fire, and we succeeded in domesticating plants and animals. Some of the achievements of this first agricultural revolution, however, produced unanticipated disease consequences. In Eurasia, the domestication of animals exposed us to zoonotic diseases that eventually jumped species and became human diseases. In tropical Africa, village settlements were subject to intense malarial infections and other vector-borne and helminthic diseases.

The populations of the disease-experienced settlements gradually expanded at the expense of populations in the hinterlands. This eventually created two distinct epidemiological zones—in Eurasia and in tropical Africa. Following the European

discovery of the Americas in the late fifteenth century, the migration of Europeans and Africans to the Americas brought about a new era of the integration of previously discrete disease environments.

The second agricultural revolution, powered by fossil fuels, produced dramatic population growth and increased trade, and launched a global process of rural-urban migration. This ushered in a new era of epidemic disease at the same time that modern allopathic medicine and the new discipline of public health began to achieve successes in the control of infectious disease and to help bring about an extraordinary extension of the human life span. This health transition gave birth in the developed world to a new era in which degenerative and lifestyle diseases such as cancer and heart disease became the leading causes of death.

The 'population explosion' initiated the rapid environmental transformation of the earth, through the conversion of biomes, such as from rainforest to farm or grazing field, and from pollution, most notably the emission of greenhouse gases.

1. Introduction

Human beings have long recognized that health and disease were in some measure a function of our relationships with our environments. Yet our understandings of these interactions remain incomplete and imperfect. This is, in part, because a very large number of environmental factors influence wellness or illness, and these influences interact with each other in complex ways that we do not fully grasp and cannot fully model. For this reason, our efforts to conceptualize illness and wellness can be only partially successful, a reflection of our limited grasp of the complexity of ecological systems more generally.

Our understandings of the historical relationships between health, disease, and our environments are in some respects even more problematic. This is in part because our knowledge of past ecological conditions is more rudimentary than our understandings of contemporary ecological conditions and because our assessments of health and disease in the past rest upon our contemporary scientific understandings of the relationships between disease agents and their hosts, and these understandings are evolving. The most basic baseline data concerning human hosts are difficult to ascertain.

Consider our historical knowledge of nutrition: Most scholars accept the proposition that an individual's nutritional status is a fundamental determinant of general health and that an inadequate nutritional status constitutes a vulnerability to disease. Yet our knowledge of historical nutrition is rudimentary. Over time the kinds of foods that we have eaten have changed, and so has the availability of food from season to season, year to year, and era to era. Thus our nutritional histories must necessarily be highly varied, as well as our susceptibilities to disease. Beyond the fact of nutritional instability, it is difficult to craft governing generalities about nutrition in the past.

Examples from other domains reinforce the uncertainties. The resources that we have used to warm or cool our dwellings have lessened our exposure to severe weather; the animals with which we have had regular contact have variously provided a bulwark

against famine; and the risks of physical injury and debilitation that we have incurred in the pursuit of sustenance and security—all have ranged greatly, according to the natural environments that our species has colonized.

Yet despite these multiple uncertainties, the most central fact in the history of our human experience shines through: over time, despite multiple setbacks, our numbers have increased greatly, and we have become the most biologically successful large animal on the planet. This population growth itself has been one of the most critical determinants of human health and disease because our experience of health and disease has been profoundly shaped by our ability to live in close proximity to one another. Our success in reproduction and maintenance of our greater numbers created the biological conditions—sufficient population densities—to allow for the transmission of infectious disease.

Our reproductive successes, of course, also generated a host of cultural accomplishments. The growth of human populations clustered in dense settlements eventually led to the development of more complex systems of social organization. These social systems, in turn, provided benefits for some population groups and at the same time created greater inequalities. The societies that were growing in complexity developed new religions that provided guidance about what constituted wellness and disease, what caused these states of being, and what could be done to promote health. Over the past few millennia, elements of these understandings have flowed between societies in far-flung parts of the world, as a result of the thickening of the webs of human interaction. In recent centuries, advances in modern medicine and public health have allowed human beings to intervene in matters of human health and disease in an unprecedented manner.

2. Earliest Patterns

Out of necessity, our earliest ancestors sought out natural environments with potable water sources, and plants that we could digest, animals that we could hunt, and/or fish that we could catch. Our ancestors used natural shelters—such as caves—when available. These resources were the *sine qua non* for successful human colonization. These colonizations were often short-lived, because human groups generally depleted the local environments and moved on when the resources proved inadequate. If contemporary gathering societies are a guide to the past, our ancestors migrated frequently in search of new resources. There were benefits to moving on. In the process they escaped from their wastes and reduced their exposure to intestinal and helminthic parasitic infections.

In this profound sense, the health of our species has always been intimately linked with our basic rhythms of drawing sustenance from our local environments. Yet, in the long epochs during which we gathered plants, hunted, fished, and sought to avoid becoming prey to raptors and large animal predators, our life expectancies were short. In the full bloom of life, we were subject to an array of parasitic diseases and opportunistic infections. On the basis of bioarchaeological evidence, our ancestors incurred a principal risk of death from the consequences that followed physical injury. Injured

human beings became more easily infected and were less able to defend themselves from non-human predators.

Yet, long before the evolution of tuber and seed cultivation and long before the settlement of the river basins and the opening up of the rainforests to village settlement, our ancestors also developed some means of self-protection. They forged cultural practices that altered their susceptibility to the mix of parasitic, bacteriological, and viral infections. The most important of these practices were made possible by the domestication of fire at least one half million years ago. Our ancestors used fire to prepare plants and meat as food. This had several beneficial consequences. Fire decreased the health risks from the consumption of recently killed animals, and a smoky evening hearth drove away flying insects, beyond the lip of the rock overhang or mouth of the cave. Smoke reduced the transmission of vector-borne diseases such as malaria.

These fire practices were efficacious, but only partly so. In tropical Africa, early family groups undoubtedly remained subject to an array of parasitic, viral, and bacterial infections. The burden of disease was high, because of the year-round warmth that supported the year-round activity of insects. Moreover, early human groups were small; they lived in close proximity to large animals that hosted parasites that were dangerous. Simian populations, for example, hosted the plasmodia of malaria and the virus of yellow fever, and over time the local mosquitoes transmitted these pathogens across the boundaries of species. Human beings also became their hosts. This disease burden cannot be estimated with exactness, but it was heavy. Experts agree that much of this burden was left behind by the small number of early migrants who trekked out of Africa sometime between seventy and fifty thousand years BCE.

For the vast majority of early human beings who did not emigrate, the costs continued to be borne, as populations began to increase. In tropical Africa, long before the evolution of permanent settlements, some family groups formed seasonal communities on the banks of rivers in order to exploit the possibilities for fishing. These communities provided on a temporary basis the critical population density to allow for the heightened transmission of some vector-borne diseases, such as malaria. Indeed, it is likely that the widespread expression in West and West Central African populations of one of the very early genetic mutations to malaria pressure in tropical Africa—Duffy antigen negativity, that fully protects against the vivax malaria parasite—constitutes the earliest genetically recorded chapter in the history of human infectious disease.

Only a few outlines, however, can be discerned in the early disease history of human beings. Much is still unknown. The broad thrust of paleo-epidemiology, however, has been to place the epochs of human prehistory in a long continuum of changing patterns of health and disease. In this respect, these scientific perspectives have moved away from the romantic conception that early human beings lived in harmony with the natural world and that the emergence of disease was the result of a shattering of the old order.

The migration of small groups of human beings out of tropical Africa more than fifty thousand years ago led to the founding of new population groups throughout the Eurasian tropics. A few of the parasites traveled with the migrants and became established elsewhere in the Old World tropics, because there were new vectors that

were capable of transmitting the parasites, as seems to have been the case with malaria. Most of the tropical African disease burden, however, was left behind. This was the case, for example, with yellow fever, guinea worm, onchocerciasis, and trypanosomiasis.

-

-

-

Bibliography

Barry, J.M. (2005). *The Great Influenza: The Story of the Deadliest Pandemic in History*, 546 pages. New York, NY, USA: Penguin. [This book provides an historical overview of the largest pandemic of the twentieth century.]

Bud, Robert. (2007). *Penicillin: Triumph and Tragedy*, 330 pages. Oxford, UK: Oxford. [This is a broad social and cultural study of the most important early antibiotic of the twentieth century.]

Cohen, M.N. (1991). *Health and the Rise of Civilization*, 296 pages. New Haven, CT, USA: Yale. [This text synthesizes research findings from several disciplines to explore the comparative health costs of populations in 'civilized' environments and those in 'primitive' settings.]

Crosby, Jr., A.W. (1972). *The Columbian Exchange: The Biological Consequences of 1492*, 268 pages. Greenwood, CT, USA: Greenwood. [This classic text explores the impact of the integration of the Old World and New World disease zones and ecologies.]

Garrett, L. (2001). *Betrayal of Trust: The Collapse of Global Public Health*, 800 pages. (New York, NY, USA: Hyperion. [This book surveys the dire condition of global public health at the beginning of the twenty-first century.]

Hart, D. and R.W. Sussman. (2005). *Man the Hunted: Primates, Predators, and Human Evolution*, 336 pages. New York, NY, USA: Basic. [This text presents a revisionist view of the relationship between human beings and predators.]

Hays, J.N. (1998). *The Burdens of Disease: Epidemics and Human Response in Western History*, 361 pages. New Brunswick, NJ, USA: Rutgers. [This is a synthesis of the evidence on the social and cultural responses to epidemic disease in the Western world.]

Kiple, K.F. (ed). (1993). *The Cambridge World History of Human Disease*, 1200 pages. New York, NY, USA: Cambridge. [This is a comprehensive survey of the history of human disease.]

Mann, Charles C. (2005). *1491: New Revelations of the Americas Before Columbus*, 465 pages. New York, NY, USA: Knopf. [This is a synthesis of recent findings on the ecological and epidemiological history of the Americas before European contact.]

McNeill, J.R. (2000). *Something New Under the Sun: An Environmental History of the Twentieth Century World*, 421 pages. New York, NY, USA: Norton. [This is a survey of environmental change in the twentieth century.]

McNeill, W.H. (1976). *Plagues and Peoples*, 376 pages. New York, NY, USA: Anchor. [This is a foundational text in the field of historical epidemiology.]

Porter, Roy. (1997). *The Greatest Benefit to Mankind: A Medical History of Humanity*, 831 pages. New York, NY, USA: Norton. [This is survey of the intellectual history of medicine and its benefits to humankind.]

Riley, J.C. (2001). *Rising Life Expectancy: A Global History*, 256 pages. New York, NY, USA: Cambridge. [This is a synthesis of evidence on the health transition.]

Rosen, G. (1958; reprint 1993). *A History of Public Health*, 535 pages. Baltimore, MD, USA: Johns Hopkins. [This is an expanded edition of the classic study of public health in the Western world.]

Webb, Jr., J.L.A. (2009). *Humanity's Burden: A Global History of Malaria*, 236 pages. (New York, NY, USA. [This is a study of the historical epidemiology of the largest killing disease in human history.]

Biographical Sketch

James L.A. Webb, Jr. is Professor of history at Colby College, where he teaches courses in world history, African history, ecological history, and historical epidemiology. He is currently writing a book on the history of malarial infections and interventions in Africa. He is the author of *Humanity's Burden: A Global History of Malaria* (Cambridge University Press, 2009), *Tropical Pioneers: Human Agency and Ecological Change in the Highlands of Sri Lanka, 1800-1900* (Ohio University Press, 2002), and *Desert Frontier: Ecological and Economic Change along the Western Sahel, 1600-1850* (University of Wisconsin Press, 1995).