

GLOBAL HEALTH IN AFRICA

Historical Perspectives on Disease Control

Edited by Tamara Giles-Vernick and
James L. A. Webb, Jr.

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INTRODUCTION

JAMES L. A. WEBB, JR. AND TAMARA GILES-VERNICK

Global health history is a new research field, and to date we know little about the histories of global health initiatives in Africa.¹ In one sense, this is quite surprising. Africa's disease burden is heavy, and international and bilateral agencies, philanthropic organizations, nongovernmental organizations (NGOs), and public-private partnerships in league with African governments have undertaken a broad array of interventions against individual diseases and into health care systems over the past many decades. Most of these interventions were time-limited, ran their courses, and were forgotten. Later iterations of these programs generally took scant advantage of the earlier experiences. There were no specialists charged with understanding the past experiences, and thus there was no systematic effort to analyze the performance of global health programs and to investigate the reasons for failure and partial success. The lessons of the past have thus remained largely unarticulated or misconstrued, unable to inform contemporary global health efforts.

Global Health in Africa is a first exploration of some of the histories of global health initiatives in Africa. The volume is published with the intention of developing the new field of global health history in order to broaden the training of a new generation of public health professionals. Our goal is to promote historical and anthropological research that integrates the social sciences and the biomedical sciences in the service of global public health.² This approach owes much to the subdiscipline of historical epidemiology, which evaluates the changing nature of disease over space and time; it integrates social, political, economic, and ecological processes with those of pathogens and with the effects of global health initiatives themselves. In bringing together biomedical and social science approaches, historical epidemiology sharpens our understandings of the biosocial causes of ill health and helps us grasp why some interventions fail.

To date, in the development, implementation, and expansion of public health projects, planners generally have not sensed a first imperative to understand the worlds in which their projects would operate. It has not been their charge to appreciate political constraints and resource scarcities or to

explore the ways in which African populations understood the biomedical interventions. They have tended to assume that there was no real need to do so, because the epidemiology and etiology of the diseases were sufficiently well known and the methods and interventions could be universally applied. The biomedical practitioners' lack of training in the social sciences made it difficult for them to appreciate the centrality of nonbiomedical perspectives.

This collection highlights some of the public health consequences of the chasm between the biomedical and social sciences that is an artifact of our system of professional education. It underscores the need to bridge the divide in order to improve the delivery of public health services. The fine-grained analyses of the past illustrate how narrowly conceived technical interventions have failed to account for specific and complex contexts into which they are introduced and how, as a result, these interventions have cast long shadows of unintended consequences. The case studies also show how long-standing policy continuities and unquestioned assumptions still guide some contemporary interventions. We have organized our sampling of global health history in Africa around these linkages between past, present, and emergent to highlight how long-term continuities play a critical, but understudied, role in global health.

Global Health

“Global health” is a term that means different things to different people and suggests different policy choices to different audiences in different geographical locations. It can imply support for rural health systems or primary care centers, individual disease control programs such as the mass distribution of insecticide-treated bed nets to reduce malaria transmission, or an effective ban on health education about contraception and abortion. Its breadth is accommodating. It allows virtually everyone to be in favor of global health. In this respect, it is an analog to the umbrella term “economic development” that likewise has meant very different things to different people at different times.³

The term “global health,” however, is also frequently used to refer to distinctive configurations of financial, political, and biomedical influence and resources in the post-World War II period. In Africa, although the actors have changed over time, the various configurations have one central element of continuity: all have been characterized by a flow of resources to Africa. Private philanthropies, international health organizations, bilateral health programs, and private-public partnerships based in the North Atlantic have developed the health initiatives and implemented them in Africa with African partner states, nongovernmental organizations, and associations.⁴ Recent Chinese investment in large-scale

health care infrastructure such as hospitals and clinics, and in health care personnel, has expanded the complement of global health actors in Africa.⁵

In this volume, we use the term “global health” broadly to refer to the health initiatives launched within Africa by actors based outside of the continent. In our usage, global health in Africa has its roots in the colonial period and came into its modern forms in the post-WWII era.⁶ This framework accommodates the continuities in external resource flows and the changing groups of actors, institutional configurations, and biomedical, financial, and political priorities.⁷

The contributors to this volume address the history of health interventions into acute and chronic infectious diseases including malaria, cholera, influenza, smallpox, and HIV/AIDS, and chronic, noninfectious conditions such as malnutrition and injection drug use. They explore interventions by European colonial and independent African state institutions, the World Health Organization (WHO), nongovernmental organizations, funding and research institutions such as the Pasteur Institute and its international network, and the US National Institutes of Health; and they explore the responses to these interventions by the Africans whose health the interventions were aimed at improving. They demonstrate that health interventions in Africa have a long history that reflects the changing interests of the intervening institutions, scientific advances in the understanding of disease, the development of new tools for intervention, and the changing nature of the international political and economic order.

The Colonial Antecedents of Global Health in Africa

The antecedents of global health in Africa have their roots in the late nineteenth century, when a new chapter in Africa’s relationship with Europe began.⁸ During the “Scramble for Africa,” competing western European powers used African military conscripts to establish political and economic influence within vast African territories, sometimes in collaboration with local African political authorities; after a transition to formal rule, the Europeans extracted resources and labor to bolster their metropolitan economies. In many of the new colonies, the Europeans forced their African subjects to gather wild rubber or to work on plantations or in mines. These working conditions, as well as African flight from colonial labor demands, heightened colonial subjects’ exposure to infectious diseases. In this regard, the imposition of European colonial rule and African responses to it provoked important changes in the disease burdens of African peoples.⁹

Africa's medical history was also profoundly changed by the introduction of Western biomedicine. In one sense, the encounter might be thought of as a collision between African medical knowledge and modes of healing and those of Europe. Specialist healers and midwives in Africa had long traditions of caring for acute and chronic illnesses and knowledge of many other conditions (including pregnancy and childbirth), and European medical authorities challenged these African practices, considering them to be primitive and inefficacious. Yet over time, Western biomedicine made inroads into African approaches to healing and was the most important contribution to a new medical pluralism in Africa. Africans with access to Western biomedicine frequently drew on both African and European medical knowledge. African forms of medical knowledge changed over time, but they largely were not displaced or entirely suppressed.¹⁰

Early in the colonial period, Europeans found their own medical knowledge inadequate to cope with the major infectious diseases in Africa.¹¹ In an effort to protect European administrators, soldiers, and merchants, European colonial powers invested resources in biomedical research, seeking new ways to understand and control the major diseases in their colonies. This research gave rise to a new discipline of tropical medicine, which developed in new schools of tropical medicine and hygiene and in research institutes in the metropolitan centers of empire and the colonies.¹² The new knowledge was soon deployed in the African colonies, principally through mobile medical campaigns to treat sleeping sickness, onchocerciasis, yaws, tuberculosis, leprosy, syphilis, yellow fever, and other diseases.¹³

European medical missionaries also launched initiatives to serve the African communities in which they evangelized. Some missionary societies set up clinics that offered rudimentary primary medical care in rural areas, and in some urban areas, missionary societies built hospitals that provided more sophisticated medical services for Africans.¹⁴ The secular colonial authorities developed a system of urban hospitals that provided medical services principally to a European clientele.¹⁵

The global economic depression of the 1930s constrained the colonial medical systems, and with the outbreak of the Second World War, the colonies adopted even more austere budgets. In the aftermath of the war, the European empires began critical reappraisals of their responsibilities to promote programs of economic and social development in their African colonies. Yet it was notably with the creation of the World Health Organization that African health issues began to be considered from broader international perspectives.

Postwar Foundations and the Changing Nature of Global Health

The World Health Organization, one of the original agencies of the United Nations, was founded in 1948. It supplanted the two existing international health organizations—the Office international d'hygiène publique and the League of Nations Health Organization—and it had a new, broader mandate.¹⁶ In the postwar world of shattered economies that were beginning to be reconstructed, massive populations of displaced persons, and the rapid polarization of the Cold War blocs, the WHO embraced the objective of the “attainment by all peoples of the highest possible level of health.”¹⁷ New medicines and insecticides were available that portended a range of new possibilities for the improvement of human health.

With limited funding from the UN member states, the WHO attracted talented physicians and public health specialists in an era of high confidence in the power of science to improve the lives of the world's peoples. It acted as a consultative body, and with funding from other UN agencies such as UNICEF, it undertook a range of health initiatives in African colonial territories or independent states, whose histories are largely yet to be explored. With its founding came the beginnings of “global health,” which owed much to colonial health, in its adoption of a vertical, “campaign”-style approach to controlling or seeking to eradicate specific diseases.¹⁸

Conceiving of its scope in “international” terms, the WHO divided the world into six regions (Africa, the Americas, Southeast Asia, Europe, the Eastern Mediterranean, and the Western Pacific).¹⁹ Its earliest, high-profile initiatives sought to eradicate specific diseases—first malaria and then smallpox—and to undertake large-scale campaigns against yaws and tuberculosis. Several historians have commented on how Cold War politics shaped both the rhetoric and the practices of these campaigns. The withdrawal of the Soviet Union and other communist countries from the WHO and the UN system in 1949 left the health institution more open to American influence, and this was notably evident in the World Health Assembly's embrace of a malaria eradication program in 1955.²⁰ When the Soviet bloc returned to the UN in 1956, the Soviets pushed an initiative to eradicate smallpox that was formally adopted by the World Health Assembly in 1959.²¹

In the 1970s, a movement to reorient health programs in Africa and elsewhere in the developing world challenged this focus on eradication and individual disease campaigns. The “basic health care” or “primary health care” movement gained momentum throughout the decade. In 1978, at the International Conference on Primary Health Care in Alma-Ata (in the Soviet

Republic of Kazakhstan), the WHO adopted a new model of health services for developing countries that promulgated the goal of “Health for All by the Year 2000.” Both China and Cuba offered models for the provision of basic health services for the rural poor.²² Missionary medicine, which had long provided basic health services in Africa and elsewhere, also contributed to this movement, emphasizing the training of village health care workers, the availability of basic supplies, and “appropriate technology.”²³

Yet even as the primary health care movement strengthened, a series of public health disasters, brought about by warfare within and between African states, called forth new externally based humanitarian public health responses. Médecins Sans Frontières, the first of a cohort of late twentieth-century secular humanitarian medical interventionist groups, formed in 1971 and committed its resources to providing frontline medical care in areas where states could not.²⁴ Other humanitarian organizations formed and followed suit.²⁵ The massive medical needs of millions of Africans in makeshift, unplanned, burgeoning refugee camps without sanitation infrastructure were framed as “complex emergencies,” a concept that proved useful in mobilizing financial resources for broad public health interventions.²⁶

Outside of the war zones, primary health care flagged. Although the Alma-Ata Declaration received approvals from many nations, the primary health care approach was dogged by difficulties in translating its ideals into practice.²⁷ Subsequently, international public health planners modified their ambitious goals and adopted the “selective primary health care” approach by targeting specific problems such as growth monitoring to ensure adequate childhood nutrition, oral rehydration techniques for childhood diarrheal infections, breastfeeding, and immunization.²⁸ The WHO’s Expanded Program in Immunization, created in 1974 prior to both Alma-Ata and “selective primary health care,” was one of the few enduring contributions of the broader movement.²⁹

The primary health care movement, however, did not attract robust, sustainable political support or funding. The governments of some African states embraced the primary health care movement, but most, despite their rhetoric, did not.³⁰ Neither the United States nor the Soviet Union offered much support; the United States associated the movement with socialism, and the Soviet Union, although it hosted the Alma-Ata meeting, also expressed misgivings.³¹ Moreover, donor support for primary health care entailed funneling monies to African governments, and both multilateral and bilateral donors were reluctant to do so. Their restraint resulted partly because health budgets were already committed, but also because of considerable uncertainty about the costs of training rural health workers, improving water quality, or other

goals.³² Concerns about the corruption, inefficiency, and instability of African governments also shaped these decisions.

Unwillingness to endorse the primary health care approach also reflected mediocre successes in promoting economic development in Africa. Large-scale agriculture and infrastructure projects generally did not meet their goals, and many development projects, such as those that involved the construction of dams for irrigation, produced a spate of unintended health consequences.³³ Moreover, development monies, whether from grants or loans, typically were disbursed from state coffers, and much was diverted. Billions of dollars made their way into the private accounts of African politicians. Even by the 1970s, it was clear to many observers that the grants and loans would not achieve their development goals, yet the funds continued to flow because they secured political allegiances.³⁴ A new shift in global health in Africa began during the 1980s, resulting in the contraction of health services on the continent. Structural adjustment policies, economic crisis, and the Soviet Union's dissolution, which brought an end to the Cold War, all reduced external resources for African health care services and contributed to deteriorating health care infrastructures.

Beginning in the late 1970s and bolstered by the elections of Margaret Thatcher as prime minister of the UK in 1979 and Ronald Reagan as US president in 1980, a conservative political discourse gained adherents. It held that bloated public sectors were responsible for slow economic growth, and that "structural adjustment" to reduce the ranks of civil servants, would liberate economic sectors of undue political interference and permit African commodities to compete freely in international markets. The International Monetary Fund imposed structural adjustment programs (SAPs) on most African economies in an effort to shrink the public sector. The public sector strictures, however, did not extend to public health expenditures. In many African countries, public health spending increased, but structural adjustment policies sought to create "economic efficiency" by implementing user fees to recover costs. Some African countries adopted the Bamako Initiative (1987) to improve primary health services through community financing. Both efforts produced mixed results. Most health spending has remained focused on hospitals and clinics in urban areas.³⁵ Structural adjustment did, however, fan an aversion to health care institution building in Africa, although many public health specialists insisted at the time that the health of African populations could be improved most significantly by expanding basic health services in primary care clinics.³⁶ This divergence in ideological outlook over the appropriate roles of the private and public sectors remains a fundamental tension into the twenty-first century.

Still another historical development shifted attention from previous decades of large-scale eradication campaigns and subsequently from primary health care investment. As the Cold War waned and the threat of nuclear annihilation diminished, security analysts perceived new threats.³⁷ The collapse of the Soviet Union led to deteriorating controls on biological weapons and scientists' activities, and security experts and public health planners openly worried that biosecurity threats could emerge from a widening array of sources and that new developments in genomics could facilitate the "weaponization" of new biological threats.³⁸ One key idea was that the increasing integration of the world economy and the increasing volume of global travel would bring forth new threats to health in the developed world. Scientific researchers and commentators argued that this accelerating globalization enhanced the prospects for "emerging disease" outbreaks, and government funding increased for research on such threats.³⁹

During the mid to late 1990s, as the HIV pandemic exploded certain "emerging disease threats" became palpably real. As US policymakers became aware of the extent of the epidemiological disaster in Africa, they judged the HIV pandemic to be a geopolitical threat that could destabilize African states and their economies. This provoked new interest in promoting "development" in order to limit the political and economic disruption that AIDS was projected to cause. Global health became further enmeshed with national security concerns.

Global health, however, was not long to remain principally the domain of governmental actors. During the 1980s, private philanthropic organizations began to insert themselves more publicly into the high-profile arena of global health.⁴⁰ Rotary International took on the challenge of the global eradication of polio with the creation of its PolioPlus program in 1985, and in 1988, the WHO, together with Rotary International, UNICEF, and the Centers for Disease Control and Prevention, passed the Global Polio Eradication Initiative.⁴¹ Following the lead of researchers at the Centers for Disease Control who advocated for the eradication of Guinea worm, the Carter Center committed itself to support national eradication projects in 1986, and other international partners signed on to the effort at global Guinea worm eradication.⁴²

Within a decade, far larger global health efforts were launched by other philanthropic organizations with far broader aspirations and far deeper pockets. In 1994, with the creation of the Bill and Melinda Gates Foundation, the role of private philanthropy in global health surpassed that of bilateral foreign aid, the WHO, and other philanthropic organizations. This heralded a new world health order.⁴³ In 2000, Bill and Melinda Gates sparked the creation of

the Global Alliance for Vaccines and Immunizations (GAVI), a private-public partnership whose members included the WHO, UNICEF, the World Bank, and representatives of the pharmaceutical industry. Between 2000 and 2011, GAVI had received donations totaling over US \$6.4 billion, of which nearly US \$1.5 billion (23 percent) came from the Gates Foundation.⁴⁴ In 2002, with seed money from the Gates Foundation, a second, larger, and more massively underwritten private-public partnership formed the Global Fund to Fight AIDS, Tuberculosis, and Malaria. Endorsed by the G-8 countries, the Global Fund, based in Geneva and administered until 2009 by WHO staff, garnered support from the taxpayers of the largest developed nations; the single largest private donor was the Gates Foundation. These partnerships have instigated massive campaigns and programs, including the Global Polio Eradication initiative, the Guinea Worm Eradication program, the provision of antiretroviral drugs to prevent the progression of HIV infections, and the mass distribution of insecticide-treated bednets throughout Africa.

In the late twentieth century and the early decades of the twenty-first century, the financial strength of the global public health organizations was thus of a higher order of magnitude than ever before. There continued to be many bilateral programs of health, such as those of the United Kingdom Department for International Development, the US Agency for International Development, China's various ministries involved in providing aid, and the Cooperation Agencies of France, Germany, Sweden, Norway, the Netherlands, Italy, and other European Union countries. Some agencies joined forces in "multilateral" initiatives. Biomedical research institutions and funding organizations also actively created new public health research initiatives around the world. The US National Institutes of Health, for instance, financed research projects that have brought together American and African university research teams. The French Agence Nationale de la Recherche (ANR) made funds available for innovative, multidisciplinary public health research and intervention in the global South, including in Africa. In France and in its network of institutes, some situated in former French colonies in Africa, the Pasteur Institute continued to carry out biomedical research on numerous infectious diseases, including HIV/AIDS, malaria, tuberculosis meningitis, and cholera. The Wellcome Trust funded ongoing biomedical research in the UK and its research institutes in the former British colonies. More nongovernmental organizations and private charities were involved in African health work than at any time in the past. The funding for global health initiatives was greater than ever before.

The decades since the 1990s have seen an escalation in funding for global health in Africa. The development of African health services, however, has proceeded slowly. Several basic measures—infant and child mortality rates, access to skilled childbirth attendants, vaccination coverage—show that sub-Saharan African health systems have not improved as quickly as in much of the rest of the developing world. Some have even stagnated.⁴⁵ A growing number of African health professionals did enter into the ranks of the international health elite, and by the late 1990s, African health professionals enjoyed some success in lobbying donor countries to increase their commitments to global health programs in Africa. In one sense, the older paradigm of the developed countries carrying out health programs in Africa had altered: health professionals in Africa who shared biomedical perspectives in common with health professionals in Europe and North America helped design and implement the programs.

The medical pluralism that combined the biomedical systems of treatment and healing developed in Europe and North America with the manifold cultures of treatment and healing in Africa, however, presented numerous challenges. Medical anthropologists made useful contributions that helped expand definitions of health problems and improve the delivery of global health initiatives. A core challenge, however, was to develop cadres of local health practitioners—such as African nurses—who could translate public health messages into African idioms and bring African perspectives into dialog with Western biomedicine.⁴⁶

Continuity in Global Health Initiatives

Against the background of important changes that have taken place—the inception of the WHO, large-scale campaigns partly inspired by Cold War politics, the “primary health care” movement, structural adjustment policies, fears of the threat of emerging diseases, the massive increase in the participation of private philanthropic organizations, and the Africanization of an international health elite—the history of global health initiatives in Africa demonstrates an important continuity. From the immediate post-World War II period to the present, global health initiatives had been characterized by a commitment to disease-specific programs. These programs target individual diseases—such as malaria, tuberculosis, HIV, measles, whooping cough, tetanus, polio, and smallpox—or indicators of health statuses, such as levels of malnutrition, maternal deaths, or access to clean water, as enshrined in the UN’s Millennium Development Goals. Some programs are both conceived and implemented from the “top down,” as in the case of polio vaccination in the Global Polio Eradication

initiative. Others have been reshaped by a much broader range of actors: demands for greater access to antiretroviral therapies, for instance, came from African communities and nongovernmental organizations, and subsequently from African states, and multilateral institutions such as UNAIDS and WHO. The activist pressure produced results: multinational pharmaceutical companies, after bearing considerable public criticism, agreed to new dispensations.⁴⁷

Donor engagement with disease-specific programs has consistently reinforced a focus on the biological agents of African diseases, rather than on the social determinants such as poverty, lack of access to resources, and income inequalities. Global public health policy in Africa has sought to increase survival rates through biomedical interventions, rather than improve the health of the poor by increasing access to primary health care. The disease-specific approach has had numerous successes. Childhood vaccinations, in particular, have proved to be highly effective in reducing deaths among younger generations, but “catch-up” programs to vaccinate older generations against preventable diseases have sometimes lagged. Other interventions, such as the provision of antiretroviral drugs to Africans with HIV, have enjoyed good success, although expansion of the programs has been constrained by the unwillingness of donors to make robust contributions during the recent global financial crisis.

To donors, the best investments in global health in Africa have consistently appeared to be disease-specific programs. They offered several key advantages. Disease-specific programs, based primarily in the biomedical sciences, offered technical solutions to achieve measurable outcomes. The implementation of such programs appeared not to require social sciences training, basic linguistic or cultural competency, or familiarity with the societies for which the interventions were planned. In principle, these technical interventions were neutral, able to be applied without entanglement in African struggles over political and economic priorities. They were also expected to produce results promptly.

The disease-specific approach had important implications for how global health projects have been conceived and implemented in Africa. Because public health specialists conceptualized diseases as primarily biological in nature, abstracted from their social, political, and economic contexts, they assumed that therapies and tools proven effective elsewhere could be applied in Africa with minimal adjustment. The disease-specific model thus considered global health interventions as a portable universal good. Experts who had proved their mettle in other world regions could consult and provide useful guidance. The social, political, and economic contexts of the delivery of health interventions were scarcely taken into account. The fact that the interventionists

generally did not speak the languages of the people who were intended to profit from the interventions ensured that the gulf in understanding was large.

Organization and Central Themes of the Volume

The essays in this collection are organized in three parts. Part I, “Looking Back,” contains four chapters that analyze colonial era interventions and reflect on their implications for contemporary interventions. The first essay, by William Schneider, focuses on the colonial-era smallpox vaccination campaigns in West Africa, in an era before the global smallpox eradication campaign. He calls these campaigns “partial successes,” and his essay sheds new light on the success of smallpox eradication by illuminating the colonial programs’ constraints, piecemeal efforts, and limited goals. What made colonial efforts only “partial successes,” Schneider argues, was a lack of international coordination and “global” framework for these vaccination campaigns. He uses lessons from this analysis to comment on recent efforts to eradicate polio.

James Webb’s essay on the first large-scale use of synthetic insecticide to control malaria brings to light the constraints faced by the pilot malaria eradication programs in tropical Africa during the era of the first global malaria eradication program. The repeated application of synthetic insecticides produced resistance in the vector mosquitoes; and the flow of people across political boundaries between Guinea and Liberia pointed up the fact that regional collaborations were essential to effective antimalarial interventions. Webb also reveals the epidemic malaria that was unleashed among the Liberian communities in the protected zones when control efforts ended. His essay demonstrates that the history of malaria eradication efforts offers important lessons for present-day malaria control efforts, in particular that the failure to sustain malaria control can lead to epidemic malaria among populations whose acquired immunities have degraded during the period of effective malaria control.

Guillaume Lachenal explores the colonial antecedents of the therapeutic approach known as “treatment as prevention” (TasP) and its relation to contemporary efforts to reduce HIV transmission. He traces a genealogy of TasP, from its beginnings in colonial mass treatments for malaria control, to the sleeping sickness and yaws campaigns of the 1920s and 1930s, through disastrous sleeping sickness treatment and prophylaxis measures in French and Belgian colonies in the 1950s. He explores how mass pentamidine use as both treatment and prophylaxis against sleeping sickness in Cameroon resulted in significant medical accidents. His essay provides an essential historical context for understanding the contemporary global health campaign for HIV.

Jennifer Tappan investigates the tangled scientific understandings of severe childhood malnutrition from the 1950s to the 1970s. Her essay explores how prevailing definitions of severe malnutrition, based on “protein deficiency,” led medical nutritional researchers to prescribe dried skim milk. This was the beginning of a global program to introduce powdered skim milk into the diets of malnourished infants and young children. Physicians did not recognize that the therapy of adding dried skim milk to food unwittingly promoted bottle-feeding with skim milk that in turn caused disastrous health consequences. Tappan’s research underlines how narrow biomedical understandings of nutrition that did not take account of the production, reception, interpretation, and long-term impact of the intervention produced entirely unanticipated outcomes. Her essay points to the need to have a broader social and cultural analysis of the reception and potential impacts of the contemporary ready-to-use therapeutic food (RUTF) such as the Nutriset product, Plumpy’nut.

Part II of this collection, “The Past in the Present,” contains essays exploring the historical dimensions and unexamined assumptions of contemporary disease control programs. Tamara Giles-Vernick and Stephanie Rupp develop new insights into the deep history of human–great ape encounters in the tropical forest. They draw on the oral evidence of Africans in the forests whose stories demonstrate that their “contact” with great apes has been fluid and multifaceted, and not always pathogenic. The authors show that the northern equatorial forests, where great apes live and where some notable host shifts have occurred, have had a long, complex, and nonlinear history of human mobility, settlement, trade, and forest exploitation. Their essay offers a historical corrective to the frequently invoked trope that early twentieth-century human incursions into the forest have provoked the emergence of new infectious diseases. It also sheds light on the difficulties of surveillance in and the “biosecuring” of ecological zones in which human–great ape contact can facilitate cross-species transmission.

Anne Marie Moulin’s contribution explores the history and broader public health significance of Egypt’s hepatitis C (HCV) epidemic. It constitutes one of the most massive iatrogenic infections of modern history, a consequence of the coercive population-level campaigns of schistosomiasis treatment from the late 1950s to the early 1980s. The infections were so widespread that HCV has become naturalized as an endemic condition. Moulin traces the processes by which Egyptian and other researchers identified the relationship between the mass treatment campaigns, what they recognized as jaundice, and what they later characterized as the world’s most serious

epidemic of hepatitis C. The coercive schistosomiasis treatment campaigns and the Egyptian government's subsequent denial of the HCV epidemic have fostered a deep popular mistrust of state public health. Moulin suggests that this mistrust has played a significant role in the ongoing political revolution that has shaken Egypt in 2011–12.

Myron Echenberg's essay investigates the seventh global pandemic of cholera that developed in Africa late in the second half of the twentieth century. He explores the multifaceted processes through which an exotic bacterium became an endemic "African" disease. Echenberg homes in on a fundamental paradox. Cholera no longer constitutes the threat that it once was in much of the world. Yet since 1995, over 95 percent of the world's cases have occurred in Africa. His essay makes clear that both biological and social explanations are necessary to explain why *Vibrio cholera* has become more widespread and lethal. He identifies political chaos, economic crises, climatic and anthropogenic environmental changes, and policy choices of governing African elites as critical factors in these outbreaks. His essay suggests that some of the most effective measures to counter the infections will be rooted in social and political choices.

Part III, "The Past in the Future," examines two fields of public health intervention in which efforts to reduce disease transmission and future harm are premised on an understanding of the past. In their chapter on medical male circumcision (MMC), Michel Garenne, Alain Giami, and Christophe Perrey offer a critique of the controversial 2007 WHO/UNAIDS recommendation to promote male circumcision as an effective measure to control female-to-male HIV transmission. They trace the history of male circumcision practices in Africa and explore past assumptions about male circumcision and its putative medical contributions. In this light they evaluate the past decade's epidemiological studies that have concluded that this intervention is efficacious. They compare the demographic evidence drawn from direct observation of HIV prevalence and incidence among circumcised and intact populations in Africa with the epidemiological evidence derived from clinical trials. They find that these two disciplinary approaches yield apparently dissonant results. The authors subsequently analyze the decision-making processes that led to the WHO/UNAIDS recommendation for male circumcision.

Sheryl McCurdy and Haruka Maruyama's chapter examines the contemporary history of heroin trafficking and use in Africa, and pays particular attention to experiences of the drug trade and its fallout in Tanzania. The authors explore the causes and consequences of different responses to heroin trafficking and use in Africa, focusing first on the US-led "War on Drugs" and then

on the “harm-reduction” approach. McCurdy and Maruyama’s essay offers a potent critique of the inability of the “War on Drugs” to eliminate drug trafficking and injection drug use. In 2006–7, the Tanzanian state, recognizing that this approach had failed to reduce either trafficking or drug use, adopted a grassroots “harm-reduction” approach to minimize the harms to drug users and to those within their social networks. The authors illuminate the broader political and social contexts that have shaped the contours of this approach in Dar-es-Salaam and determined its efficacy.



Africa has long served as a laboratory for human research and experimentation.⁴⁸ Its disease environments and public health challenges have called forth a succession of interventions that are increasingly the focus of a new generation of scholarship in the field of historical epidemiology. The essays in this collection address some of the most important interventions in disease control: mass vaccination, large-scale treatment and/or prophylaxis campaigns, harm-reduction efforts, and nutritional and virological research. Despite the technological promise offered by both research and intervention, the enthusiasm of their proponents, and the successes of some of the interventions, many of these efforts have had far-reaching, unanticipated social and medical consequences for African populations. The essays illustrate vividly the need for a fuller integration of social science and biomedical perspectives, in order to translate global health initiatives to local needs, capacities, and constraints and to better anticipate the social consequences of these interventions. This will require the multidisciplinary training of public health specialists. Global health practitioners need to understand African conceptions of disease etiology, African therapeutic practices, and the various political, economic, and resource constraints that affect African access to medical care. The study of past efforts, part of the emerging field of global health history, is a powerful tool to allow us to grasp more fully the nature of the contemporary challenges.

Notes

1. Some recent works in historical epidemiology have explored the histories of individual diseases. For exemplary studies of HIV/AIDS and cholera, see John Iliffe, *The African AIDS Epidemic: A History* (Athens: Ohio University Press, 2006), and Myron Echenberg, *Africa in the Time of Cholera* (New York: Cambridge University Press, 2011). For an overview of African historical epidemiology, see James L. A. Webb, Jr.,

“Historical Epidemiology and Infectious Disease Processes in Africa,” *Journal of African History* 54, no. 1 (2013): 3–10.

2. Medical anthropologists recently have called for the development of a new field of global health diplomacy to bring health care professionals into dialog with foreign-policy professionals and medical anthropologists to address the problems of failed public health initiatives. See Vincanne Adams, Thomas E. Novotny, and Hannah Leslie, “Global Health Diplomacy,” *Medical Anthropology* 27, no. 4 (2008): 315–23. For a survey of the discipline of anthropology’s engagement with global health, see Craig R. James and Kitty K. Corbett, “Anthropology and Global Health,” *Annual Review of Anthropology* 38 (2009): 167–83. For essays that explore the narratives of international epidemics, see Sarah Dry and Melissa Leach, eds., *Epidemics: Science, Governance and Social Justice* (London: Earthscan/Routledge, 2011).

For a reflection on the role of history in health policy making with special reference to the UK, see Virginia Berridge, “History Matters? History’s Role in Health Policy Making,” *Medical History* 52, no. 3 (2008): 311–26.

3. H. W. Arndt, *Economic Development: The History of an Idea* (Chicago: University of Chicago Press, 1989).

4. For an example of African NGOs and association activities, see Vinh-Kim Nguyen, *The Republic of Therapy: Triage and Sovereignty in West Africa’s Time of AIDS* (Durham, NC: Duke University Press, 2010).

5. Barry Sautman and Yan Hairong, “Friends and Interests: China’s Distinctive Links with Africa,” *African Studies Review* 50, no. 3 (2007): 75–114.

6. Some scholars have interpreted the broadening effectiveness of the twenty-first-century WHO disease surveillance networks as marking a fundamental transformation under way in the aftermath of the 2003 SARS (severe acute respiratory syndrome) epidemic. See, for example, David P. Fidler, “Germs, Governance, and Global Public Health in the Wake of SARS,” *Journal of Clinical Investigation* 113, no. 6 (2004): 799–804, and Lorna Weir and Eric Mykhalovskiy, *Global Public Health Vigilance: Creating a World on Alert* (New York: Routledge, 2010).

Recently, George Dehner has examined the WHO influenza surveillance system that operated in earlier decades, bringing to light continuities over time. He notes that there were other expert groups within the WHO that developed policies to counter threats to global health, including for other diseases such as influenza that were not required to be reported to health authorities (George Dehner, *Influenza: A Century of Science and Public Health Response* [Pittsburgh: University of Pittsburgh Press, 2012], 15).

7. Oliver-James Dyer and Ayesha de Costa, “What Is Global Health?” *Journal of Global Health* 1, no. 1 (Spring 2011), accessed online at <http://www.ghjournal.org/spring-2011-issue>; Andy Haines, Antoine Flahault, and Richard Horton, “European Academic Institutions for Global Health,” *Lancet* 377 (January 2011): 363–65; Ilona Kickbush, “Mapping the Future of Public Health: Action on Global Health,” *Revue canadienne de santé publique* 97, no. 1 (2006): 6.

8. H. L. Wesseling, *Divide and Rule: The Partition of Africa, 1880–1914*, trans. Arnold J. Pomerans (New York: Praeger, 1996); Thomas Pakenham, *The Scramble for Africa: The White Man’s Conquest of the Dark Continent from 1876 to 1912* (New York: Avon, 1992);

A. Adu Boahen, *African Perspectives on Colonialism* (Baltimore: Johns Hopkins University Press, 1989).

9. The most extensive disease problem appeared to be trypanosomiasis, also known as sleeping sickness. It became epidemic among African populations in several territories. The colonial medical campaigns to control trypanosomiasis involved forced relocation and medical coercion, and the early drugs used produced devastating consequences for many of the survivors. The medical campaigns are best documented in northern Zaire and French Equatorial Africa. See Maryinez Lyons, *The Colonial Disease: A Social History of Sleeping Sickness in Northern Zaire, 1900–1940* (Cambridge: Cambridge University Press, 2002); Rita Headrick, *Colonialism, Health, and Illness in Equatorial Africa, 1885–1935*, ed. Daniel Headrick (Atlanta: African Studies Association, 1994); Jean-Paul Bado, *Eugène Jamot, 1879–1937* (Paris: Karthala, 2011); Kirk Arden Hoppe, *Lords of the Fly: Sleeping Sickness Control in British East Africa, 1900–1960* (Westport, CT: Praeger, 2003). For the broader history of trypanosomiasis, see John Ford, *The Role of the Trypanosomiasis in African Ecology: A Study of the Tsetse Fly Problem* (London: Oxford University Press, 1971).

Africans who labored in mines ran a major risk of disease from tuberculosis and silicosis, and the sufferers were sent away from the mines to die elsewhere. See Randall M. Packard, *White Plague, Black Labor: Tuberculosis and the Political Economy of Health and Disease in South Africa* (Berkeley: University of California Press, 1989); Elaine N. Katz, *The White Death: Silicosis on the Witwatersrand Gold Mines, 1886–1910* (Johannesburg: University of Witwatersrand Press, 1994).

10. See Steven Feierman and John Janzen, eds., *Health and Healing in Africa* (Berkeley: University of California Press, 1992); John Janzen, *The Quest for Therapy: Medical Pluralism in Lower Zaire* (Berkeley: University of California Press, 1978); Julie Livingston, *Debility and the Moral Imagination in Botswana* (Bloomington: Indiana University Press, 2005).

11. Europeans had, however, achieved major reductions in the mortality and morbidity among European troops in Africa and elsewhere in the tropics, beginning in the 1850s. See Philip D. Curtin, *Death by Migration: Europe's Encounter with the Tropical World in the Nineteenth Century* (New York: Cambridge University Press, 1989). On the disease problems of the Europeans involved in the military conquest of the continent, see Philip D. Curtin, *Disease and Empire: The Health of European Troops in the Conquest of Africa* (Cambridge: Cambridge University Press, 1998).

12. The literature on the emergence of tropical medicine is extensive. For some representative approaches, see Michael Worboys, “The Emergence of Tropical Medicine: A Study in the Establishment of a Scientific Specialty,” Gerard Lemaire et al., eds., *Perspectives on the Emergence of Scientific Disciplines* (The Hague: Mouton, 1976), 75–98; Michael Worboys, “Tropical Diseases,” in *Companion Encyclopedia of the History of Medicine*, ed. W. F. Bynum and R. Porter (London: Routledge, 1993), 1:512–36; Warwick Anderson, “Immunities of Empire: Race, Disease, and the New Tropical Medicine,” *Bulletin of the History of Medicine* 70, no. 1 (1996), 94–118; John Farley, *Bilharzia: A History of Imperial Tropical Medicine* (Cambridge: Cambridge University Press, 2003); David Arnold, ed., *Warm Climates and Western Medicine: The Emergence of Tropical Medicine* (Amsterdam: Rodopi, 1996); Anne Marie Moulin, “The Pasteur Institutes between the

Two World Wars: The Transformation of the International Sanitary Order,” in *International Health Organizations and Movements, 1918–1939*, ed. Paul Weindling (Cambridge: Cambridge University Press, 1995).

13. Jean-Paul Bado, *Médecine coloniale et grandes endémies en Afrique, 1900–1960: Lèpre, trypanosomiase humaine et onchocercose* (Karthala: Paris, 1996); Headrick, *Colonialism, Health, and Illness in Equatorial Africa*; Heather Bell, *The Frontiers of Medicine in Anglo-Egyptian Sudan, 1889–1940* (New York: Clarendon Press, 1999).

14. Ralph Schram, *The History of the Nigerian Health Services* (Ibadan: Ibadan University Press, 1971), 59–180. This book covers a far broader field of historical study than indicated by its title.

On the social history of missionary medicine, see David Hardiman, ed., *Healing Bodies, Saving Souls* (Amsterdam: Rodopi, 2006); Nancy Rose Hunt, *A Colonial Lexicon of Birth Ritual, Medicalization, and Mobility in the Congo* (Durham, NC: Duke University Press, 1999); Megan Vaughan, *Curing Their Ills: Colonial Power and African Illness* (Stanford, CA: Stanford University Press, 1991), chap. 3; John Comaroff and Jean Comaroff, *Of Revelation and Revolution*, vol. 2, *The Dialectics of Modernity on a Southern African Frontier* (Chicago: University of Chicago Press, 1997); Terence Ranger, “The Influenza Pandemic in Southern Rhodesia: A Crisis of Comprehension,” in *Imperial Medicine and Indigenous Societies*, ed. David Arnold (Manchester: Manchester University Press, 1988), 172–88; John Manton, “Making Modernity with Medicine: Mission, State, and Community in Leprosy Control, Ogoja, Nigeria, 1945–50,” in *The Development of Modern Medicine beyond the West: Historical Perspectives*, ed. Hormoz Ebrahimnejad (New York: Routledge, 2009), 160–83; David Simmons, “Religion and Medicine at the Crossroads: A Reexamination of the Southern Rhodesian Influenza Epidemic of 1918,” *Journal of Southern African Studies* 35, no. 1 (2009): 29–44.

15. William H. Schneider and Ernest Drucker, “Blood Transfusions in the Early Years of AIDS in Sub-Saharan Africa,” *American Journal of Public Health* 96, no. 6 (2006): 984–94. On urban hospitals in colonial Zimbabwe, see Tamara Giles-Vernick, Susan Craddock, and Jennifer Gunn, “Mobility Restrictions, Isolation, and Quarantine: Historical Perspectives on Contemporary Debates,” in *Influenza and Public Health: Learning from Past Pandemics*, ed. Tamara Giles-Vernick and Susan Craddock (London: Earthscan/Routledge, 2010), 201–2, 205.

16. The Office international d’hygiène publique, formed in 1907, was largely concerned with overseeing international rules for quarantining ships to prevent the spread of plague and cholera. The League of Nations Health Organization, in principle, had a broad mandate, but it was an underfunded organization with a small staff that depended fundamentally on the pro bono advice of European and US public health experts. On the League of Nations Health Organization, see Iris Borowy, *Coming to Terms with World Health: The League of Nations Health Organization, 1921–1946* (New York: Peter Lang, 2009).

17. “The Constitution of the World Health Organization,” Article 1 in *Basic Documents of the World Health Organization*, supplement 2006 (Geneva: World Health Organization, 2006), 2.

18. On the imperial roots of eradication in the Americas, see Nancy Leys Stepan, *Eradication: Ridding the World of Diseases Forever?* (London: Reaktion Books, 2011), 35–64.

19. Theodore M. Brown, Marcos Cueto, and Elizabeth Fee, “The World Health Organization and the Transition from ‘International’ to ‘Global’ Public Health,” *American Journal of Public Health* 96, no. 1 (2006): 64.

20. J. A. Gillespie, “Europe, America, and the Space of International Health,” in *Shifting Boundaries of Public Health: Europe in the Twentieth Century*, ed. Susan Gross Solomon, Lion Murard and Patrick Zylberman, Rochester Studies in Medical History, vol. 12 (Rochester, NY: University of Rochester Press, 2008), 114–37, esp. 124–32; Socrates Litsios, “Malaria Control, the Cold War, and the Postwar Reorganization of International Assistance,” *Medical Anthropology* 17 (1997): 255–78; J. Siddiqi, *World Health and World Politics: The World Health Organization and the U.N. System* (London: Hurst and Company, 1995).

21. Erez Manela, “Smallpox Eradication and the Rise of Global Governance,” in *The Shock of the Global: The 1970s in Perspective*, ed. Niall Ferguson et al. (Cambridge, MA: Harvard University Press, 2010), 251–62; Stepan, *Eradication*, 120–23; Brown, Cueto, and Fee, “World Health Organization,” 64–65.

22. Stepan, *Eradication*, 227.

23. Marcos Cueto, “The Origins of Primary Health Care and Selective Primary Care,” *American Journal of Public Health* 94, no. 11 (2004): 1865.

24. Humanitarian medicine owed its beginnings to colonial medical and Christian missionary activities, the International Red Cross, Second World War relief organizations such as Catholic Relief Services and CARE, and to the UN High Commission on Refugees, created in the aftermath of World War II (Michael Barnett and Thomas G. Weiss, eds., *Humanitarianism in Question: Politics, Power, Ethics* [Ithaca: Cornell University Press, 2008]; Guillaume Lachenal and Bertrand Taithe, “Une généalogie missionnaire et coloniale de la médecine humanitaire: Le cas Aujoulat au Cameroun, 1935–1973,” *Le mouvement social*, no. 227 [2009]: 45–63; Patrick Aeberhard, “A Historical Survey of Humanitarian Action,” *Health and Human Rights* 2, no. 1 [1993]: 30–44).

During the Nigerian civil war (1967–70), humanitarian groups offered basic medical and nutritional services to those targeted by or caught in violent conflict. This emergency led to the development of Médecins Sans Frontières (Doctors without Borders), and the proliferation of interventions that expanded beyond efforts to secure “basic survival” (Peter Redfield, “Doctors, Borders, and Life in Crisis,” *Cultural Anthropology* 20, no. 3 [2005]: 331); Michael Barnett, *Empire of Humanity: A History of Humanitarianism* [Ithaca: Cornell University Press, 2011]).

25. Over subsequent decades, new humanitarian medical organizations proliferated, including Action contre la faim (1979), Oxfam (1995), and the UAE-financed, France-based Women and Health Alliance International (2009), as well as centers within academic institutions, such as Harvard University’s François-Xavier Bagnoud Center for Health and Human Rights in the School of Public Health, founded by the AIDS researcher/activist Jonathan Mann. Since the 1970s, humanitarian medical interventions have taken place in Sudan, Somalia, Rwanda, the Democratic Republic of Congo, Mozambique, and elsewhere in Africa (Neil Middleton and Phil O’Keefe, “History and Problems of Humanitarian Assistance in Sudan,” *Review of African Political Economy* 33, no. 109 [2008]: 543–59; Johan Pottier, “Roadblock Ethnography: Negotiating Humanitarian Access in Ituri, Eastern DR Congo, 1999–2004,” *Africa* 76, no.

2 [2006]: 151–79; Steven Robins, “Humanitarian Aid beyond ‘Bare Survival’: Social Movement Responses to Xenophobic Violence in South Africa,” *American Ethnologist* 36, no. 4 [2009]: 648).

26. Jennifer Leaning, Susan M. Briggs, and Lincoln C. Chen, eds., *Humanitarian Crises: The Medical and Public Health Response* (Cambridge, MA: Harvard University Press, 1999); Ezekiel Kalipeni and Joseph Oppong, “The Refugee Crisis in Africa and Implications for Health and Disease: A Political Ecology Approach,” *Social Science and Medicine* 46, no. 12 (1998): 1637–53.

27. Stepan, *Eradication*, 228–29.

28. Marcus Cueto notes that some planners contended that selective primary health care complemented the Alma-Ata Declaration, while others believed that it contradicted the 1978 measure. Cueto, “Origins of Primary Health Care,” 1868–69.

29. *Ibid.*, 1870. In the 1980s, “Child Survival Programs” were the core focus of the selective primary health care programs; by the mid-1990s the focus had shifted to the “Integrated Management of Childhood Diseases.”

30. Kwesi Dugbatey, “National Health Policies: Sub-Saharan African Case Studies (1980–1990),” *Social Science and Medicine* 49, no. 2 (1999): 223–39.

31. Cueto, “Origins of Primary Health Care,” 1867.

32. *Ibid.*, 1871. The WHO’s recent assessment of primary health care appears in *World Health Report 2008 (Now More Than Ever)*, <http://www.who.int/whr/2008/en/index.html>.

33. William R. Jobin, *Dams and Disease: Ecological Design and Health Impacts of Large Dams, Canals, and Irrigation Systems* (London: E & FN Spon Press, 1999).

34. George B. N. Ayittey, *Africa Betrayed* (New York: Palgrave Macmillan, 1993).

35. David Sahn and Rene Bernier, “Have Structural Adjustments Led to Health Sector Reform in Africa?” *Health Policy* 32, nos. 1–3 (1995): 193–214; Lucy Gilson and Anne Mills, “Health Sector Reforms in Sub-Saharan Africa: Lessons of the Last 10 Years,” *Health Policy* 32, nos. 1–3 (1995): 215–43.

36. Hilary Standing, “An Overview of Changing Agendas in Health Sector Reforms,” *Reproductive Health Matters* 10, no. 20 (2002): 19–28.

37. Andrew Lakoff and Stephen J. Collier, eds., *Biosecurity Interventions: Global Health and Security in Question* (New York: Columbia University Press, 2008), and Andrew Lakoff, “Preparing for the Next Emergency,” *Public Culture* 19, no. 2 (2007): 256–58.

38. Joshua Lederberg, ed., *Biological Weapons: Limiting the Threat*, BCSIA Studies in International Security (Cambridge, MA: MIT Press, 1999); Jonathan B. Tucker, *Scourge: The Once and Future Threat of Smallpox* (New York: Atlantic Monthly Press, 2001).

39. Nicholas King traced how an “emerging diseases worldview” captured American scientific, media, and public attention during the 1990s (Nicholas B. King, “Security, Disease, Commerce: Ideologies of Postcolonial Global Health,” *Social Studies of Science* 32, nos. 5–6 [2002]: 763–89).

40. Private philanthropic engagement, of course, was not new. The Rockefeller Foundation, created in 1913, had carried out medical initiatives in the southern states of the USA, the Caribbean, Central America, and South America, although it had ratcheted back its public health activities after the Second World War (John Farley, *To*

Cast Out Disease: A History of the International Health Division of the Rockefeller Foundation [1913–1951] [New York: Oxford University Press, 2003]). In the United Kingdom, the Wellcome Trust, founded in 1936, became the largest philanthropic funder of biomedical research in Europe.

On international health organizations and movements after the First World War, see Paul Weindling, ed., *International Health Organizations and Movements, 1918–1939* (Cambridge: Cambridge University Press, 1995).

41. David Heymann, “Global Polio Eradication Initiative,” *Bulletin of the World Health Organization* 84, no. 8 (2006): 595.

42. Sandy Cairncross, Ralph Muller, and Nevio Zagaria, “Dracunculiasis (Guinea Worm Disease) and the Eradication Initiative,” *Clinical Microbiology Reviews* 15, no. 2 (2002): 223–46.

43. In the late 1990s, the WHO adopted the term “global health” in preference to the term “international health,” in an effort to shore up its position in the changing configuration of global health actors. See Brown, Cueto, and Fee, “World Health Organization.”

44. GAVI Alliance, *Progress Report 2011*, downloaded March 26, 2012, at <http://www.gavialliance.org/>.

45. World Health Organization, *World Health Report 2008*.

46. See, for instance, Rachel R. Chapman, *Family Secrets: Risking Reproduction in Central Mozambique* (Nashville: Vanderbilt University Press, 2010); Barry L. Hewlett and Bonnie S. Hewlett, *Ebola, Culture, and Politics: The Anthropology of an Emerging Disease* (Belmont, CA: Thomson Wadsworth, 2008).

47. David Barnard, “In the High Court of South Africa, Case No. 4138/98: The Global Politics of Access to Low-Cost AIDS Drugs in Poor Countries,” *Kennedy Institute of Ethics Journal* 12, no. 2 (2002): 159–74; Michael Zisuh Ngoasong, “The Emergence of Global Health Partnerships as Facilitators of Access to Medications in Africa: A Narrative Policy Analysis,” *Social Science and Medicine* 68 (2009): 953–54.

48. The history of science in Africa during the colonial period has been more thoroughly explored for the British colonies than for other European imperial powers. On science in British Africa, see Helen Tilley, *Africa as a Living Laboratory: Empire, Development, and the Problem of Scientific Knowledge, 1870–1950* (Chicago: University of Chicago Press, 2011), and Joseph M. Hodge, *The Triumph of the Expert: Agrarian Doctrines of Development and the Legacy of British Colonialism* (Athens: Ohio University Press, 2007).

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