CHAPTER 1

Introduction

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ENVIRONMENT AND MOVEMENT

Throughout history in the Indian Ocean World (IOW) diseases have, under certain distinctive geographical and climatic conditions, emerged and spread, generating a number of impacts on varying spatial scales. The IOW, a macro-region lying between latitudes 45°S and 45°N running from Eastern Africa through the Middle East, South and Southeast Asia to East Asia, encompasses tropical, sub-tropical, and temperate zones, major oceans, gulfs and rivers, islands, lakes and deserts, and the world's highest mountain range (Map 1.1). It thus experiences major differences in temperature and rainfall, which are further affected by other environmental factors—the most significant of which is the monsoon system of winds and currents that governs the IOW littorals and seas north of about 12°S of the equator. In the northern hemisphere summer, the southwest monsoon dominates, bringing heavy rainfall to the Asian littoral, while in winter the

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system switches direction, creating the northeast monsoon. Most historians have assumed the monsoon system to have been stable, but it could unpredictably fail, triggering drought, crop failure, famine, and disease. A range of other, often associated, environmental factors, such as the El Niño–Southern Oscillation (ENSO), Indian Ocean Dipole (IOD), Intertropical Convergence Zone (ITCZ), volcanism, and cyclones could also significantly impact temperature and rainfall and thus disease. For example, in the aftermath of heavy rain, stagnant pools of water could form, providing breeding grounds for mosquitos and other causal agents of diseases such as malaria, filariasis, dengue, and chikungunya (cf. Meunier 2014). Again, heavy monsoons, cyclones, seismic activities, tsunamis, and storm surges could lead to flooding that might in turn create favourable conditions for pathogenic microorganisms and thus for the spread of water-borne and contagious diseases such as cholera, dysentery, and polio or *Escherichia coli* infections. Furthermore, weather extremes and natural disasters were often followed by famines, conflict, and migration, all of which increase health hazards.

In addition to these environmental specificities—this “deep structure” of the IOW (cf. Pearson 2003)—the macro-region witnessed the rise of the first “global” economy from around 300 BCE. The IOW global economy, linking Eastern Africa and the Middle East to China and all places in between through the creation of a sophisticated network of overland, riverine, and maritime communication, was characterized by an intensifying exchange of plants, animals, and (both voluntary and involuntary) humans—creating the quintessential conditions for disease diffusion. This process, which started with early hominid migration out of Africa, triggered the development of regionally specific immunological responses. With the advent of long-distance trans-IOW seafaring, the entanglement of humans and pathogens gained a novel epidemiological momentum affecting both littoral and hinterland communities (cf. Campbell 2019; Schnepel and Alpers 2017; Pearson 2015; Alpers 2014; Sheriff 2010). The interconnected character of the IOW global economy, and increasing concentration of human and animal populations close to water resources, transformed the IOW into one interconnected disease zone (Issa 2006; Arnold 1991). It formed, for example, a centre of dispersion of a number of diseases such as the plague, smallpox, malaria, and tuberculosis.

However, disease outbreaks and dispersion did not occur in a historically linear fashion. The IOW global economy underwent major cycles of expansion and contraction. The main eras of economic expansion were

from approximately 300 BCE to 300 CE, between the ninth and thirteenth centuries, and again from the mid-nineteenth century—the intervening periods being marked by general stagnation. Times of overall economic prosperity, characterized by enhanced agricultural productivity and demographic growth, were not immune from outbreaks of disease. However, it is notable that some of the most notable and devastating episodes of disease, such as the first and second plague (541 and 1347 CE) and cholera (e.g. 1817 and 1826 CE) pandemics, not only originated in the IOW but erupted during periods of major economic uncertainty (Campbell 2019).

Within this context, there is considerable debate about the European impact on the IOW. For some scholars, such as Arnold, the advent of the European presence from 1500 marked a major epidemiological watershed for the IOW (Arnold 1991). However, Campbell argues that, in contrast to the New World to which Europeans carried Old World diseases that had a catastrophic impact on indigenous populations, the reverse was generally true in the IOW where Europeans proved highly vulnerable to tropical diseases. This was, for example, the case with malaria to which many African populations had, through genetic adaption (sickle cell), acquired resistance. Thus the Portuguese in Mozambique suffered such high mortality from malaria that they often lacked sufficient soldiers to maintain a garrison. For largely the same reason, European attempts to found settlements in Madagascar failed. Only with the widespread adoption of quinine from the late nineteenth century could European soldiers and colonists settle malarial regions of the IOW (Campbell 2019 and contribution to this volume).

The nineteenth century marked a major turning point in the disease history of the IOW for a number of reasons, many of which were related to the rise of a truly international economy that, by the eve of the First World War, had drawn all but the most peripheral societies into the orbit of modern capitalism. First, with the exception of railways in India, and of late nineteenth-century investment in mining in South Africa, few areas of the IOW benefitted from the enormous outflow of capital to extra-European regions from financial centres, notably London and Paris, based in Western Europe. Consequently, growing demand for tropical and semi-tropical products from a rapidly industrializing West resulted in a commercial boom in the IOW that was largely labour intensive. This was the case with both European and indigenous enterprise in the macro-region. Manpower was required to clear land and cultivate cash crops such as

Map 1.1 The Indian Ocean World (IOW). © IOWC

cloves, sugar cane, coffee, tea, and cocoa; collect forest products such as gum and tropical hardwoods; hunt and extract prized animal products such as ivory, rhino horn, skins, pearls, and whale oil; transport such produce to ports, and carry imported articles into the interior; load and offload commodities at ports; and provide the crews of commercial vessels. However, in the 1800s the IOW failed to experience the same rates of demographic expansion as the West, and, as much labour was already tied up in indigenous forms of bondage, there existed a very limited wage labour force from which to hire workers. As a result, European and indigenous IOW authorities, traders, and entrepreneurs, resorted largely to the use of bonded labour. This was reflected in the continued use of slaves and the increased use of penal and especially of indentured labour. There

developed a large-scale system of bonded labour movements, both intra-IOW and from the IOW to labour markets in other regions of the world, such as the Caribbean, characterized by labour shortages. These large-scale long-distance movements, which continued well into the twentieth century, brought immunologically naïve people into contact with previously unknown diseases and environmental conditions. Such mobile or displaced people, in turn, carried diseases, predispositions for certain conditions, and specific immunological responses to new locations (Campbell 2018, 2014; Sheriff and Ho 2014).

Additionally, the nineteenth and twentieth centuries were marked by major imperialist ventures, both European and indigenous, in which there occurred massive movements of troops and camp followers. Military expeditions often led to significant displacements of populations, both combatant and non-combatant. At the same time, the presence of major concentrations of male soldiers and workers resulted in a rise in the transmission of sexually transmitted diseases (STDs) and of alcoholism. First, such concentrations of males (few European females accompanied white soldiers to the IOW, and indentured labourers were predominantly male—overwhelmingly in the case of the Chinese) established a huge demand for sexual services. This in turn resulted in an often officially encouraged system of recruitment and migration of young women from mostly impoverished backgrounds, who were often forced into the provision of such services. Inevitably, these systems resulted in an explosion in the transmission and diffusion of sexually transmitted diseases. Massive concentrations of male soldiers and workers also led to an unprecedented rise in, and growing public concern about, alcohol consumption. This theme is explored in this volume by Peter Hynd and Manikarnika Dutta who reveal that, in nineteenth-century India, alcohol was a highly lucrative trading commodity that some officials considered to be a panacea for certain deadly diseases such as cholera and the bubonic plague. Official tolerance of the production and sale of alcohol encouraged European seamen and soldiers to consume it, often in adulterated form, on unprecedented levels. However, missionaries in the field, and members of a burgeoning temperance movement in Western Europe and North America, argued with increasing force that alcohol was hazardous to health and morality.

The nineteenth and twentieth centuries were also characterized by an ever accelerating series of technological advances that further propelled disease dispersion. This was particularly the case with transport innovations, notably the expansion in the use of railways from the mid-nineteenth

century, steamships from the 1870s, civil aviation from the 1930s, container and liner shipping from the 1950s, and long-haul flight mass tourism and travel in the modern era (cf. Alpers 2014; Mitchell 2016).

DISEASE IN IOW HISTORY

Disease has played a crucial role in shaping the size, movement, and settlement patterns of human populations as well as their peaceful or conflict-driven encounters. Moreover, thinking about and acting upon disease is central to all world views and thus provides a window into how societies perceive events and their progression. Hence, disease serves as an indispensable cornerstone in the reconstruction of human history. Disease is experienced, socially understood, and governed, in the broader understanding of Foucault (2011), as comprising governmental interventions as well as techniques of self-control. This allows for a wide range of investigative approaches that include the addressing of individual experiences of illness, the social organization of care, and institutional interventions.

This volume views the study of disease as essential to an understanding of the key historical developments underpinning the foundation of contemporary IOW societies. In this exercise, it is necessary first to define what we mean by “disease” and second to examine the exchange dynamics of pathogens and healing techniques across both the terrestrial and maritime zones of the IOW. We here follow historian Andrew Cunningham’s identification of three fundamental dimensions of disease as “(1) an *experience*—an experience of debilitation, pain, suffering, together with (2) the spontaneous *appearance of non-customary phenomena* with respect to the body, such as spots, vomiting, sweating, aches, and (3) ... *outcomes* of recovery, death or disability” (Cunningham 2002, 13). Furthermore, humans “seem to insist on seeking reasons or *causes* for disease: for its incidence, its origin, its course, its outcome” (ibid.).

The origins and routes of disease in the IOW were both terrestrial and maritime. The fourteenth-century pandemic of bubonic plague, commonly called the Black Death, offers a prime example of the terrestrial origins and diffusion of disease. There exist three endemic foci of rodent populations that carry *Yersinia pestis*, the organism that causes bubonic plague: the Eurasian steppe (between Manchuria and the Ukraine), Himalayan foothills, and Great Lakes region of East Africa. The second plague pandemic started probably in China in the 1330s. It erupted because of two occurrences: an epizootic of the plague amongst the rodent population and sustained contact between the affected rodents and

humans. These were probably coterminous and related to major environmental events that upset the habitat and challenged the immune system of the rodents. First, from about 1300, China entered a prolonged period of economic and political turbulence. Second, East and Southeast Asia experienced major climatic and environmental disturbances. In China, the early 1330s were characterized by excessive rain and flooding, while in 1334, Mount Kelud in Eastern Java erupted with a volcanic flux magnitude comparable to the 1815 Tambora eruption ($f \approx 26.3 \text{ kg km}^{-2}$). Such eruptions resulted in reduced temperatures for two to three years, and harvest shortfalls, often accompanied by famine and disease. During these early fourteenth-century events, an epizootic of plague erupted amongst a population of rodents, forcing them to flee their natural habitat and seek refuge and food in communities of humans, to which the pathogen-carrying fleas transferred from the dying rodents. The disease affected visiting traders, subsequently travelling with some of them along the overland Silk Road to the Near East and Europe: this route ran from China's Mongolian border across Central Asia to Neyshabur (Nishapur), in North-Eastern Iran, from where major trade routes ran to Northern India, Mesopotamia, and on to the Persian Gulf or the Mediterranean, and north via the Caspian Sea to Russia. At the pace of 30 km a day, it would have taken such traders and the plague just over four months to travel from China's Mongolian frontier to Neyshabur. Approximately halfway lies Lake Issyk-Kul, near which are located two mediaeval cemeteries of Nestorian Christian traders. These reveal that at least 106 of the 650 people buried there between 1186 and 1349 died in 1338–1339—and that “pestilence” was marked as the cause of death of at least 10 of them. It is estimated that in Europe, the Black Death killed one third or more of the population (Campbell 2019; Reid 2018; Bos et al. 2016; Sussman 2011; Cohn and Weaver 2006).

Whereas human diseases emanated overwhelmingly from land-based sources, the development of transoceanic voyaging ensured that ships, their cargoes, crews, and passengers also constituted highly significant factors in the long-distance transmission of disease. Most scholarly work on the bio-cultural history of intentional and unintended transoceanic exchange of diseases has focused on the Atlantic in the era of European expansion (e.g. Crosby 1972). Only following David Arnold's seminal 1991 article emphasizing the epidemiological distinctiveness of the Indian Ocean have the maritime spaces of the IOW entered the academic discourse on disease zones of exchange and transformation (Arnold 1991). The early domestication of animals, development of densely populated

trading hubs, and rise of trans-IOW oceanic sail allowed for germ exchange across the maritime spaces of the macro-region from about 300 BCE—well before the European incursion into the IOW from around 1500. Arnold, whose focus was specifically on the Indian Ocean, stressed the development of “epidemic highways” (*ibid.*, 4).

Not least of these were criss-crossing pilgrim routes, notably those of the Muslim hajj to Mecca, which constitutes “one of the greatest, and longest lasting, maritime passenger traffics in the world” (Pearson 2015, 9). Due to the IOW’s deep pre-colonial historical interconnectedness, the European impact was not as abrupt and catastrophic as in the New World (Arnold 1991, 5). Nevertheless, as Arnold points out, “the emergence of India as the lynch pin of British power and trade in the East was of great epidemiological significance for the rest of the region and indeed the wider world beyond” (*ibid.*, 7). In the contemporary era, the IOW has witnessed the eruption in epidemic and pandemic forms of a number of diseases such as dengue, chikungunya, SARS, Zika, and subtypes of influenza (Weaver and Lecuit 2015; Zeller 1990; Alpers, Jansen this volume).

THE ROLE OF ISLANDS

Of notable significance in disease formation and distribution processes in the IOW were islands (cf. Falola et al. 2019; Pearson 2003; Alpers 2000, 2014)—the focus of five of the chapters in this volume (i.e. Alpers, Campbell, Jansen, Knoll, Warren). Taking advantage of the “laboratory” quality of island settings (cf. Cliff et al. 2000), these contributions reveal in condensed form processes of disease formation, dispersion, and management. As tracts of land surrounded by water, islands are separated, even isolated, as well as bridged and connected by water. Islands thus were both convenient outposts on the peripheries of countries, societies, and empires, and indispensable nautical nodal points in complex maritime networks. As crucial stopovers in trade, stepping stones in migratory movements, and gates to continental hinterland resources and power, islands were also, inadvertently, pivotal centres of endemic disease formation, of virulent epidemic invasion, and of the exchange and expansion of diseases.

Indeed, islands were overexposed to specific health hazards. Smaller islands, often densely populated, were vulnerable to resource scarcity, seasonal storms, drought, and flooding—which often created unique disease environments that challenged the human immune system. Plantation projects on larger islands such as Java and the Philippines could have last-

ing impacts on human health and wellbeing. Some islands, such as the Maldives and Madagascar, even gave their names to supposedly distinctive fevers. In addition to ecological factors, islands could be precariously dependent on sea traffic and the changing fortunes of the IOW global economy. Some islanders, notably those in pivotally strategic locations along the IOW maritime networks, such as coastal Ceylon, Sumatra, and Java, as well as on smaller islands such as Anjouan and Mahé, were in early and regular contact with voyaging seafarers, traders, and travellers. At the centre of inter-regional and cross-IOW exchange, they were shaped by cosmopolitanism and sexual relations across racial and ethnic boundaries. Islands were distinctive disease dispersion hubs. Genetic founder effects weighed heavily on small populations, and epidemics travelled fast through close-knit island communities. Moreover, the enduring turbulent history of many IOW islands led to the juxtaposition of multi-ethnic and multi-religious populations with corresponding social tensions and conflict dynamics, as is conspicuous, for example, in the case of Sri Lanka.

Their geographical location, and historical circumstances, made some islands epidemiological avenues to hinterlands and staging posts along the epidemic highways in the IOW disease zone. Domination of islands and littorals was thus about controlling not only trading routes but also the pathways and speed of epidemics. Discrete island spaces that existed in abundance in many parts of the Indian Ocean, and were generally manageable due to their small size, served also as liminal spaces, usable, for example, as quarantine islands or leper colonies.

EARLY DISEASE CONTROL AND TREATMENT

One of the major human reactions to disease in the IOW was the development and exchange of therapeutic efforts of disease control and treatment (Issa 2006), and theoretical considerations of disease cause and transmission. The IOW is the birthplace of some of the world's oldest medical systems, and a space of intensive exchange of healing techniques, materials, and knowledge. This included the exchange and interlocking dynamics of therapeutics, *Materia medica*, and skilled practitioners of the Ayurveda, Chinese, Tibetan, Yunani (Arab-Persian) medical systems, as well as of Prophetic and Islamic medicine, and non-textual healing rituals and practices (Winterbottom and Tesfaye 2016). Moreover, the IOW was a laboratory for emerging scientific fields such as virology, malariology, parasitology, and tropical medicine. Major biomedical breakthroughs

occurred in the macro-region, including the discovery in India in 1897–1898, by future Nobel laureate Ronald Ross, of malaria transmission by the *Anopheles* mosquito. Quinine, the most widely used prophylaxis for malaria, appears in the IOW to have been first used in Madagascar (Campbell, this volume)—after Jesuits gained knowledge about the traditional medical use of the ground bark of cinchona trees by the Quechua, a people indigenous to Peru, Bolivia, and Ecuador, and transferred this knowledge to Europe in the later sixteenth century. The most recent form of health-related mobility in the IOW is the development of a thriving medical tourism industry with major centres in Singapore and Bangkok, and a correlating increase in medical travel by international patients (e.g. Knoll 2017).

Three decades after David Arnold's seminal article, and three years after the subject was further enhanced by a collection edited by Anna Winterbottom and Facil Tesfaye (2016), this volume sets out to shed further light on the dispersal and impact of disease in the IOW. Disease knows no political or man-imposed frontiers, and some pandemics, such as cholera in the nineteenth century, crossed the entire macro-region which, as noted above, runs from Eastern Africa in the West to China in the East. Indeed, cholera, like plague and some other diseases emanating from the IOW, spread beyond the IOW proper. Time wise, this volume covers the *longue durée*, from the arrival of early hominids in the IOW up to the twenty-first century. The dynamics of various diseases are here reflected against the backdrop of major transformations in the mobility of humans within the IOW and their interaction with disease. IOW mobility covers travel on foot, mules, camels, and horses and by everything from animal-drawn carts, railways, cars, buses, and sail and steam ships to aeroplanes. Moreover, medical history has, over the centuries, progressed from the study of miasma-based disease and, by the latter part of the nineteenth century, germ-based disease, to a post-Second World War focus on molecular and gene-based disease. The available sources for a reconstruction of IOW medical history have thus expanded, from purely symptomatic patient descriptions, to predominately anatomic definitions of disease (following the initial use of dissections during the Renaissance), to what Michel Foucault has called “the clinical gaze” in the mid-nineteenth century—that is, to ever more detailed test results focusing on disease as a composition of symptoms, rather than a reliance on the subjective descriptions of patients (Foucault 1973), and since the 1990s to DNA analysis and to ancient DNA (aDNA) sequencing.

ORIGINS, ROUTES, AND IMPACT OF DISEASE

Debates over the origin, dispersion, and impact of disease form a central focus of this volume. In their chapter, Monica H. Green and Lori Jones reconstruct the pre-modern trajectories of malaria, tuberculosis, leprosy, smallpox, and plague in the IOW, although they caution that more ancient DNA needs to be retrieved in order to fully incorporate the macro-region into molecular narratives of global medical history.

Malaria is caused by the protozoan parasite *Plasmodium*, four species of which are responsible for the disease in humans: *P. vivax*, *P. falciparum*, *P. malariae*, and *P. ovale*. In this study, Green and Jones focus on the two most dangerous species, *P. vivax* and *P. falciparum*. The older *vivax* strain is associated with an Asian and the *falciparum* with an African centre of distribution. *P. vivax* may have passed, in modified form, from primates to humans. It possibly became most prevalent when the hominid migrants out of Africa became settled rice farming communities. *P. falciparum*, by contrast, appears to have originated as a human disease in Africa 10,000 years ago and to have diffused geographically chiefly through the slave trade: it spread throughout the Roman Empire and travelled via the trans-Atlantic slave trade to the Americas where it found particularly fertile ground on sugar and cotton plantations.

Tuberculosis seems to have an East African origin, although more virulent TB strains were introduced to the IOW with European colonialism. Smallpox was probably another quintessential IOW disease, originating from human-camel-rodent interactions in the Horn of Africa in the second millennium BCE. Those who survived initial attacks developed life-long immunity to it, so smallpox could only thrive by moving as a “childhood disease” between communities. IOW trade networks provided it with the ideal means of dispersion. Again the slave trade may have played a pivotal role. Prolonged physical intimacy, such as that which existed in concentrated groups of slaves, seems to have been key to the transmission of the slowly replicating leprosy organism. Current academic thinking is that the plague had a Northern Eurasian origin, although there is an intriguing possibility that all three plague pandemics may have originated within the IOW: the first “Justinian” plague pandemic in East Central Africa (Campbell 2019) from where it spread via maritime routes to Ethiopia and Egypt, the second in Central Asia from where it spread via the Silk Road, and the third in Yunnan, China, from where it initially dif-

fused slowly via overland routes and then became global through maritime routes.

In her chapter in this collection, Anna Winterbottom demonstrates commonalities and connectivity across the IOW in how people understood the “Frankish disease” and treatments for it. In Sub-Saharan Africa and Southeast Asia, references to the Frankish disease, considered to have been the same as the “Great Box” disease, or syphilis, in Europe, were rare or absent. The presence of forms of the malady caused by other strains of the bacterium *Treponema pallidum*, such as the non-venereal yaws, seems to have prevented these areas of the IOW from experiencing major epidemics of syphilis. Elsewhere in the IOW, the Frankish disease was generally believed to have been caused by close contact with foreigners. Tracing symptoms and epidemiological blaming across the IOW, Winterbottom demonstrates that in the IOW derivatives of the term *afrang* (from ancient Persian for “Frank”—i.e. the “Frankish disease”) were used to refer to syphilis, the suspected transmitters of which were frequently Europeans and the prostitutes they frequented. During the colonial era, the earlier perception of the Frankish disease as originating with Europeans was reversed.

Some of the early treatments for the Frankish disease remained in limited local use, while others spread. A few, such as *Guaiacum* from Central America, *Smilax* or “China root”, and mercury, became global remedies. Winterbottom concludes that medical cultures within and beyond the IOW shared some basic understanding of health as rooted in a balance of key bodily substances. The Frankish disease triggered changes in medical thinking in the IOW by associating concepts of contagion with specific groups of people.

Eric A. Strahorn, in his contribution to this volume, reassesses the debate about the early dispersion of leprosy in the IOW from the vantage point of fresh insights from palaeopathology. Bringing literary and archaeological evidence into dialogue with DNA sampling, Strahorn develops a pathology history of the progression of interpretations and transmission theories of “Hansen’s disease”, as leprosy is also called. The physical manifestations of lepromatous leprosy, the more severe of the two main types of Hansen’s disease, which include extensive skin lesions, loss of extremities, and a collapse of the nose, may be identified in disease descriptions found in a number of ancient Chinese, Indian, Egyptian, and circum-Mediterranean texts. Such sources suggest the presence of leprosy in India by the second millennium BCE, and in ancient Egypt, the Roman

Mediterranean, and China by the third century BCE. Archaeological evidence supports this chronology. One influential modern hypothesis proposed that the armies of Alexander the Great carried leprosy from India to the Mediterranean. Critics, however, point to the particularly slow incubation period of *M. leprae* of three to ten years and suggest an alternative hypothesis—that leprosy travelled along age-old trade routes linking India and the Mediterranean. Strahorn considers that, since the diagnosis of leprosy in skeletal remains is complicated, and the majority of skeletons with leprosy-attributed bone damage have been found in Europe, DNA evidence has the potential to fill gaps in the literary and archaeological record. Nevertheless, the lack of aDNA samples from many parts of the IOW, notably India, still leaves many questions unanswered about the role of the IOW in the early dispersion history of leprosy.

In his chapter, James Francis Warren examines the health impacts of climate, weather, and colonialism in the Philippines from the sixteenth century. Consulting sources from the colonial and post-independence periods, Warren draws a picture of an archipelago afflicted by successive adversities. Natural disasters, such as typhoons and droughts, often triggered outbreaks of disease. Arid periods, especially during El Niño events, could lead to the drying up of wells and rivers with, as a result, limited and unsafe supplies of drinking water that often triggered the outbreak of disease. Again, floods, common during the rainy season, often precipitated health problems including coughs, fever and flu, water-borne diseases such as cholera, typhoid fever, amoebic dysentery, diarrhoea, and mosquito-borne diseases.

Cholera, which frequently erupted in the wake of typhoons and floods, was the most feared of water-borne diseases. Seven major cholera outbreaks occurred in the Philippines during the nineteenth century, five of them linked to El Niño events. The Spanish colonial government relied heavily on the assistance of various Catholic religious orders and charitable donations for disaster relief and assistance. This proved insufficient, however, and what remained of the Spanish health system broke down under American rule from the late 1890s. In the post-colonial era, the Philippines have struggled with both ever accelerating population growth and the lack of adequate drinking water and sewage disposal systems. In poor rural and low-lying areas, as well as in urban agglomerations, cholera and typhoid remained major health threats. This was manifest, for instance, in the 1970s when the Philippines experienced a devastating series of typhoons and floods. Since then, rapid climate change, increased population density,

and a growth in monocrop cash crops at the expense of food crops, have intensified the incidence and impacts of natural misfortunes and thus the vulnerability of the Filipino people to epidemics.

In his contribution, Gwyn Campbell examines the onset and spread of malaria in nineteenth-century highland Madagascar. “Madagascar Fever” early earned a notorious reputation amongst European visitors to the island and can be identified with reasonable certainty as malaria. Campbell shows that in Madagascar, the distribution and impact of malaria was determined by a mixture of climate, geography, and human activities. The disease probably arrived in the island with the first permanent settlers from East Africa in the eighth or ninth century CE. These pioneers comprised mixed or separate groups of Bantu speakers, who had sickle cell immunity to malaria, and Austronesians, who possessed no natural defences to malaria. This favoured the survival in Madagascar of Bantu speakers or those of mixed Bantu-speaking and Austronesian heritage who were sicklers. Later Austronesian arrivals (the proto-Merina) migrated to the central plateau chiefly to escape the largely endemic fevers of the lowlands. Attempts by Europeans, following their incursion into the IOW, to found settlements in the Malagasy lowlands largely failed due to malaria to which they proved highly vulnerable. The central highlands, at an altitude of 1300 to 1700 metres, were reputedly malaria free, but the evidence is that there, too, malaria became endemic in the course of the nineteenth-century, epidemic outbreaks occurring probably as early as the 1820s. This change in malaria epidemiology was connected to changing climatic conditions, notably warmer weather that facilitated the survival of mosquitos at higher altitudes, and to forced labour (*fanompoana*) policies that induced unprecedented flows of people between the malarial lowlands and the traditionally parasite-free highlands. This resulted in high mortality rates amongst highlanders. Also, people fled the land in order to avoid exploitative forced labour recruitment. In so doing, they abandoned labour-intensive rice fields and the water channels that fed them, clay-brick pits, and alluvial gold diggings, which created numerous reserves of stagnant water that provided ideal breeding ground for the malaria vector *Anopheles funestus* that spread from the eastern lowlands into the highlands.

In their contributions to this volume, Peter Hynd and Manikarnika Dutta examine the relationships between disease in colonial India, the production, regulation, consumption, and taxation strategies of alcohol, and colonial governance. In analysing the impact of disease in the context of alcohol consumption and social behaviour, these authors reveal two

seemingly contradictory attitudes to alcohol which was, on the one hand, considered destructive of health, even a disease in its own right, and on the other was thought of as a remedy.

Focusing on Bombay Presidency, Peter Hynd explores the impact of the IOW disease environment, especially the major disease outbreaks of the late nineteenth century, on colonial governance. He examines official claims about the relationship between disease, alcohol consumption, and excise revenue, and evaluates these claims against mortality statistics. Scrutinizing recurring references to plague and other diseases in the official colonial excise records, Hynd demonstrates that, although disease did not have a serious impact on excise revenues in late nineteenth- and early twentieth-century India, excise department officials often invoked disease, especially in epidemic form, to justify striking increases or decreases in excise revenues. They argued, for example, that alcohol consumption decreased when people fled cities during disease outbreaks, such as the 1896–1897 plague epidemic that ravaged Bombay. The return of disease fugitives to the city after the crisis, and the widespread belief that liquor constituted a prophylactic against plague, probably led to increased alcohol consumption and thus a spike in excise revenues in 1897–1898. However, colonial excise agents were trapped between the imperative to enhance revenue and the increasingly critical voices of missionaries, temperance advocates, and nationalists, who denounced alcohol consumption. In colonial India, tax officials adopted a “maximum revenue from minimum consumption policy” to limit the drinking of alcohol, impose basic hygiene standards on distillers, and repress adulteration. Disease was a most welcome “explanation that worked” for the British Raj tax authorities to justify fluctuating excise revenues.

In her contribution, Manikarnika Dutta examines the impact of alcohol on the health and behaviour of sailors in nineteenth-century Calcutta. British authorities in India were worried about both the alcohol consumption of European sailors in Indian port cities and the low quality of local liquor. They were highly concerned about the drinking binges that sailors engaged in during shore leave and the “crimping system” whereby “crimps”—a particular term for a fraudster—enticed sailors to consume drugged liquor and subsequently tricked, mugged, and robbed their victims. Colonial officials started to investigate the quality of local liquor when reports proliferated of “treacherous” Indians tricking “innocent” European sailors into drinking “poisonous” liquor. Cheap, adulterated liquor was considered a health threat to white sailors and even envisaged

to be a cause of cholera. Regulating the quality of liquor and its production and consumption facilities was therefore of paramount importance to British authorities. The temperance movement also campaigned against liquor consumption and related unruly activities, while the installation and administration of sailors' homes in port cities also helped to counter crimping and excessive drinking. Dutta investigates the extent to which the colonial state's measures to protect the health of European mariners were informed by imperial encounters in the fields of medical intervention, race relations, environmentalism, and legal order.

In his chapter, Edward A. Alpers extrapolates from a specific focus on the recent chikungunya epidemic in the western IOW to comment more generally about diffusion mechanisms of epidemic diseases. The RNA virus that causes *chikungunya* (a word used by the Makonde of Northern Mozambique and Southwest Tanzania meaning "that which bends up"—referring to the sufferer's severe joint pain) originated in two virus lineages in Africa and, in the late nineteenth century, developed a genetically distinct Asian virus genotype. The 2004 outbreak of chikungunya affected 75 percent of the population of Lamu Island, Kenya. It is thought that direct exchange between humans and mosquitos (i.e. independent of animal intermediaries), and intensified air travel, caused a rapid transmission of the disease, both to more distant island groups in the Western Indian Ocean such as Mombasa, the Comoros, the Mascarene Islands, and the Seychelles, and to India where in 2005–2006 over a million people were affected across 13 states. Mutations in the various chikungunya virus strains enabled additional mosquito species, such as the Asian tiger mosquito (*Aedes albopictus*), to become effective chikungunya vectors. This adaptation led to the re-emergence and rapid spread of chikungunya in the IOW some 50 years after the first authoritative identification of the disease in Tanganyika.

Alpers explores the academic debates surrounding the origins and recent expansion of chikungunya, including the virus-vector-environment dynamics of its aptly called Indian Ocean Lineage. The chikungunya pandemic demonstrates that this arthropod-borne virus can adapt and invade new hosts through mutation. With this insight, Alpers also reconsiders the malaria epidemics on the Mascarenes in the 1860s and poses three main questions for future research. First, could the *Anopheles* mosquito vector of the disease have survived a lengthy boat voyage from mainland Africa to these mid-ocean isolates? Second, did a critical mass of human malaria carriers then travel to these islands, enabling already existing populations of

mosquitoes to become vectors and cause a malaria epidemic? And third, did a genetic mutation, similar to that which triggered the 2004–2007 chikungunya epidemic, transform existing mosquito populations into effective vectors for the *Plasmodium* parasite?

In her chapter, Karine Aasgaard Jansen examines the 2005–2007 chikungunya epidemic in Réunion, a French overseas department. As a social anthropologist, Jansen focuses on the social impact of this vector-borne disease in the context of local disease perceptions and the islanders' resistance to public health interventions. The Réunionese had never before experienced chikungunya, and many of them interpreted the disease in relation to the malaria outbreaks of the 1950s. The location of the breeding grounds of the *Aedes* mosquitos in the *jardin creole*—the garden adjoining, and much cherished by, traditional Réunionese households—as well as local people's experiences with previous public health interventions against vector-borne diseases, contributed to the popular stigmatization of chikungunya. Islanders viewed mosquitos as familiar entities in local gardens and French public health agents carrying out mosquito control as trespassers invading the intimacy of the private garden. Moreover, elderly Réunionese associated chikungunya public health interventions with their past experiences of governmental malaria control measures that targeted unsanitary households. This led to the stigmatization of chikungunya sufferers as people whose neglect of domestic hygiene resulted in the creation of mosquito breeding grounds. Stigmatization, in turn, led many Réunionese to reject the idea that chikungunya was a vector-borne disease. At the beginning of 2006, when the chikungunya epidemic peaked—over 25,000 new cases being registered in a single week—there was a widespread belief that the disease was the result of a medical or military experiment, the workings of a chemical plant, or even of a terrorist attack. This heightened public opposition to official health agents. Thus, Jansen argues, public health interventions may have contributed to an increase rather than a decrease in the impact of chikungunya on Réunion during the 2005–2007 epidemic.

In the final contribution to this volume, Eva-Maria Knoll draws an arc from a legendary historical malady to the current impact of malaria-causing parasites in the Republic of Maldives. This small archipelago, lying at the crossroads of the IOW maritime trade routes, has the world's highest rate of a care-intensive inherited blood disorder (beta-thalassaemia). With its current focus on genetic risk, public health discourse in the Maldives is turning the tropical paradise islands into a thalassaemia risk-alert social

world. It does not, however, offer a causative explanation for the archipelago's exceptional thalassaemia burden.

Knoll investigates European and Arab historical reports of the “Maldivian fever”, a malady that most scholars assume to have been malaria. These reports date back about six centuries, starting with Muslim traveller Ibn Battuta in the fourteenth century, followed by castaway François Pyrard de Laval, East India Company surgeon David Campbell, Archaeological Commissioner of Ceylon H.C.P. Bell, and, in the late nineteenth century, collector and explorer Carl Wilhelm Rosset. By the mid-twentieth century, the small Maldives island habitats were recognized as mixed infection zones where the local population had to struggle with three different malaria parasites, the health impacts of which reinforced historical eyewitness reports of inescapable and deadly fever. WHO malaria control activities started comparatively late, in the mid-1960s, but were highly successful. By the mid-1970s, the deadly malaria parasites had been eradicated from the islands and soon thereafter were also eliminated from the collective memory of the Maldivian population.

DISEASE DISPERSION: TRACING DYNAMIC BIOSOCIAL PHENOMENA

This volume comprises contributions on disease dispersion and impact from a number of academic and scientific angles, including history, social and medical anthropology, archaeology, epidemiology, and palaeopathology. These show that disease-causing agents often took advantage of Anthropocene environmental transformations such as deforestation, monoculture, and irrigation systems, and that they adapted to new environmental circumstances.

Diseases are highly *dynamic biosocial phenomena*, which often makes it difficult to identify them retrospectively and trace them in the historical record (Cooter and Stein 2013; Cunningham 2002; Arrizabalaga 2002; Wilson 2000). DNA analysis demonstrates that some pathogens in the IOW have relatively stable genomes. This is the case, for example, with *Mycobacterium leprae* (which causes leprosy), which has changed little over at least the last 1000 years. Other pathogens, however, may alter considerably over time. Their biological dynamic allows diseases to emerge unexpectedly; to strike, retreat, and re-emerge; and to affect a specific locality, where they might become endemic, or expand in the form of epi-

demics and even pandemics. Evolutionary mutations enable diseases to change genetically, offering them the potential to transmute, move, and adapt to new environments and circumstances (Alpers, this volume).

Here, we consider diseases to be both “real entities” and “thought entities” (Cunningham 2002, 15)—both biomedical realities and the results of historically produced knowledge, analysed according to either naturalist-realist or historical-conceptualist perspectives (Wilson 2000). The naturalist-realist approach uses modern concepts of disease and biomedical diagnosis to examine what historian Piers Mitchell (2011) calls “social diagnosis” made by people in the past. Thus some scholars identify malaria with certain historical descriptions of “fever”. By contrast, the historical-conceptualist approach acknowledges that a general understanding of the nature of a specific disease is embedded in the “thought collective” of a particular time and society (Fleck 1979). Aetiological and epistemological theorizing, by consequence, may change over time. Such changes in the descriptive and diagnostic categories of disease are sometimes difficult to discern (Strahorn, this volume).

Most contemporary medical historians adopt a mixed approach, combining the methodologies used in the humanities with those employed in biomedicine, molecular biology, and genetics, in order to shed new light on historic categories and descriptions. The chikungunya virus, for example, was identified scientifically in 1952 and thus distinguished from dengue and the broader fever category (Alpers, this volume). Since “fever” is a comprehensive disease category used extensively in historic descriptions, some aetiological confusion between dengue, chikungunya, malaria, and other variants of tropical fever characterizes the medical history of the IOW (Kuno 2015, Knoll, this volume). Genomic studies of tuberculosis (TB), by contrast, have expanded the TB category to the *Mycobacterium tuberculosis* complex (MTBC), comprising several species of the causative organism. Furthermore, they have shown that tuberculosis is much younger than hitherto assumed. Rather than representing a prehistoric disease originating from “out-of-Africa” migrations, tuberculosis dates back only 4000 to 4500 years (Green and Jones, this volume).

Sequencing ancient DNA (aDNA), retrieved from bones and dental remains, is the most recent development in the methodological toolkit for the reconstruction of human ailments and disease in history (Hagelberg et al. 2015; Strahorn, this volume). Though technically challenging, and of limited utility in the reconstruction of infectious and genetic disease history, aDNA results provide new kind of data. This invites, if not obliges,

a reassessment of previous historical data and resulting insights and arguments that were largely based on European text sources.

This volume invites readers to consider disease in history from both a life science and social science/humanities perspective. Such an approach takes pathogen and gene pools as well as disease perception and experience into account. However, the poor preservation of human skeletons, especially in the warm and humid climates of the IOW, imposes a serious limitation on the aDNA revolution. Thus Green and Jones (this volume) argue that no pathogen aDNA samples of any of the five major infectious diseases of the IOW—malaria, tuberculosis, leprosy, smallpox, and plague—have yet been retrieved from this macro-region. Finally, the disease history of the IOW also reveals a wide range of perceptions about disease aetiologies and epidemiologies. For example, some IOW communities believed that disease was linked to supernatural forces or blamed it on social “others”—such as Indian “coolies”, immigrants, slaves, the crews of visiting ships, pilgrims, or colonizers.

In sum, this collection focuses on disease dispersion across time, space, and various cultural settings rather than on, for example, the large field of culture-specific diseases captured as culture-bound syndromes or folk illnesses. It will hopefully stimulate scholars to engage in other, interdisciplinary studies, of the biosocial dispersion of disease in the IOW, past and present.

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