Epidemics, Matter, Significance, and Responsibility

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Like the coronavirus, another contagious, airborne, respiratory, and viral disease has escaped collective immune responses and medical interventions through mutated variants to create destructive pandemics. The influenza virus shows that epidemics cannot be understood or controlled through the old beliefs that nature and culture are ontologically separate and dichotomous. This article first explores the entangled being of influenza using a historical method and a short case study from Brazil. In the late 19th century, Brazilians recognized an influenza pandemic in ways that thoroughly integrated matter and significance. Next, the article discusses influenza from biological, chemical, and ecological perspectives. I argue that the properties of influenza viruses and other infectious diseases are not self-revealing or a reflection of ourselves, but something in between and among, objects dynamically marked, shaped, and receptive to new translations into human language and understanding. This position calls for a different epidemiological ethics that discards other unhelpful dichotomies (life/ non-life, harmful/ harmless germs, healthy/ ill) to bring us an ethics of epidemiology best rooted in the relational and radiant ontology of Buddhist belief.

Introduction: Eras of Epidemics

COVID-19 has jolted us out of our complacence. It has made us aware that our existence is fleeting and dependent on our relations with billions of people and countless more animals and organisms who share the world with us. With anxious eyes we look ahead, but we may also look back. History reveals that the world has entered a new age of infectious diseases, including HIV/ AIDS, Ebola, human monkeypox, multi-drug resistant strains of bacteria, Zika, and coronaviruses (SARS, MERS, COVID-19). Their virulence is biological, like the transfer of a virus through intimate contact, the invisible film of a touched surface, or molecules in a breath of air. Yet epidemics cleave and splinter through their social virulence: epidemic diseases are experienced through their location within pre-established hierarchies. In other words, these diseases are never egalitarian in their impact; those who are assumed to have ‘caught’ the insidious power to infect others evoke violent fears that cling to old prejudices. COVID-19 “continues to unleash a tsunami of hate and xenophobia, scapegoating and scare-mongering” exclaimed United Nations Secretary-General Antonio Guterres in 2020.[1]

The new era of epidemics results from the good and bad that globalization brings. Greater and faster movements of people and products mean a larger and quicker movement of germs and vectors. In past phases of globalization, new technologies opened mass migration and international commerce and helped facilitate new epidemic diseases and their understandings. In fact, historians have recorded two periods characterized by an increase in terrifying plagues in the last 500 years. When the first Europeans and enslaved Africans crossed the Atlantic Ocean in the late 15th and 16th centuries, they unknowingly carried a set of deadly diseases that depopulated the Americas. The specific afflictions that killed millions of indigenous peoples are not known; but most probably they were smallpox, measles, and influenza. Europeans took advantage of the devastation to win wars, enslave, occupy, and settle.

The second era of epidemics began in the 19th century when revolutions in industry and transportation set into motion another wave of mass migration. Rapidly evolving urban centers became hubs for infectious diseases, among them cholera, typhoid, dysentery, tuberculosis, and influenza, all contingent on a steady stream of mostly poor and desperate migrants for dispersal. This period of epidemics helped create more activist and surveilling governments and resulted in a wave of public health measures that redefined notions of personal liberty and state responsibility. Health surveillance and interventions were legitimated by new ways of understanding disease-causing microorganisms and revolutionary drug discoveries.

When the second era of epidemics ended in the mid-20th century, many leaders in wealthier nations were left with a false sense of security. Modern medicine and public health have vastly changed human relationship with infectious diseases, reduced mortality rates, and extended life spans, although much less in poorer countries. ‘Miraculous’ tools like vaccines, antibiotics, and organ transplants gave science and medicine the appearance of nearly unlimited power to reduce nature’s dangers. The idealism and optimism of the mid-20th century has since faded, such as when each tool showed its limits and problems. The

World Health Organization (WHO) and powerful governments failed to repeat their victory over smallpox in other global disease eradication campaigns, many pathogens developed resistance to antibiotics, thousands of bodies gradually rejected transplanted organs, and millions of people now view vaccines as the weapons of elite conspirators.

The third and current era of epidemics began with HIV/ AIDS in the 1980s, a pandemic of equal parts prejudice and the human immunodeficiency virus. Again, globalization significantly reduced the degrees of communicative separation among humans, but viruses and other microbes show that our connectedness was never ours alone. Environmental degradation, poaching, and wildlife trades facilitate outbreaks that are less likely to be confined to regions and nations. The viruses causing HIV/ AIDS, Ebola, Zika, SARS, MERS, COVID-19, and human monkeypox have 'spilled over' from animals to humans, threatening global populations. As pathogens invade new hosts, older and more familiar scourges such as yellow fever, malaria, and dengue fever dramatically extend and move their regional threat in part due to climate change. These epidemics, and especially HIV/ AIDS and COVID-19, have added to a collective shock in public health's vulnerability, destabilizing ideas of progress and control.

New treatments have saved millions of lives. Still, medical technology hardly seems any closer to delivering humanity toward a utopic state of pain-free virility. In 1959, at one of the high points in optimism in medical progress, René J. Dubos bristled at the use of the term "'miracle' in referring to the effect of a new drug", suggesting that medicine inspired faith "as though part of a priesthood".[2] Since then, medicine has removed the fangs and claws from HIV/ AIDS, making it a 'manageable' disease. So many communities can now escape its terror and despair, yet HIV/ AIDS permanently lodged itself in more than 1.5 million new bodies across the world in 2021, and many of the infected live in places where expensive medicine and monitoring remain out of reach.[3] Other widespread diseases, like tuberculosis, methicillin-resistant Staphylococcus aureus (MRSA), and *Clostridioides difficile* increasingly escape our 'miracle' antibiotics by evolving resistant strains and turning hospitals into dangerous breeding grounds. In less than six months, teams of scientists spanning the globe invented powerfully effective vaccines against COVID-19. As quickly as new gene-splicing mRNA vaccines exceeded expectations in trials, their manufacturers and traditional authorities struggled against a wave of pervasive popular preventatives and treatments. The FDA, CDC, and WHO use their billion-dollar budgets to lecture the public against chloroquine or ivermectin, but proud communities give their trust to acquaintances and politicians (and foreign operatives). Governments have exercised unprecedented forms of social control, such as biometric tracking, remote sensing of crowds at travel hubs, and the 'lockdown' or mandatory in-home detention of millions of people for weeks or months within cities, territories, or entire nations. While these measures have saved many lives, some are politically expedient for small groups of powerful people. From HIV/ AIDs to COVID-19, prejudice, gullibility, and distrust create rich soil to grow seeds of power and fortune.

The unfolding pandemic and our current era of epidemics shows that infectious diseases arise, act, or are acted upon, and dissipate or are controlled through what Andrea Patterson and I call their 'S-H-A-P-E-S', or their 'Socio-Historical, Artistic, Political and Ecological Significance'. Understanding epidemics in this way demands a radically collaborative approach, drawing contributors from closely related and vastly distant fields in the search for innovative ways to address human suffering; and to find real solutions that may determine whether people live or die. The SHAPES approach is needed within an increasingly interconnected world that exposes the uniqueness of each disease and epidemic in its place and time and the shared experiences that span human life and death.[4]

At the time of writing, SARS-CoV-2 and its multiple evolving variants have sickened at least a half-billion and killed six million people — beloved grandparents and parents, kind neighbors, and dear children. When the virus arrived in early 2020, it was strange and frightfully alien. Yet this viral family has a long relationship and evolutionary history with people: SARS-CoV-2 belongs to a large family of zoonotic pathogens (with transmission from animals to humans) that have been widely present in diverse bat and bird species, along with humans, for millennia. Researchers describe ancient coronavirus lineages with common microbial ancestors dating back millions of years.[5] Coronaviruses have likely sparked epidemics as or more severe in the past, perhaps evolving into the lineages of those generally benign and ubiquitous common colds we get many years.

Eras of epidemics are also eras of reconfiguration and interconnection. All that which are reconfigured and interconnected concurrently demonstrate their shape, fit a shape of our understanding, and make/ show new shapes through new tools. I illustrate this argument with two perspectives of influenza's social and natural history. The article begins with an influenza outbreak in Brazil during the late 19th century. I use it to elucidate the article's central argument that all epidemics have 'SHAPES'. In other words, epidemics cannot be understood or controlled through old and mostly Western beliefs that nature and culture are ontologically separate and dichotomous. In the second part, I argue that scientists may observe matter, but matter does not passively reveal its meaning. The sense we make of or what we do with things like the club-shaped spikes (peplomers) that 'crown' the SARS-CoV-2 come from our dense social networks that knit together families, communities, and societies, all sharing modes of communication that rest on inherited and shifting belief systems. The 'matter' of epidemics, or the physical properties of infectious diseases, are not a *tabula rasa*, self-revealing picture, or talking mirror. Rather, as the next section will explain, they are more like a Rosetta Stone, objects already dynamically marked and able to 'fit' new translations into human language and understanding. Empirical methods and powerful observational technologies may translate molecular composition, evolutionary passageways, and pathogenic mechanisms into new life-saving interventions, such as new medicines, vaccines, and other prophylactics. Nevertheless, as quickly as scientists invent and improve vaccines against COVID-19, millions of other people invent and build upon complex and emotional reasons to reject such bodily interventions. Fears rest on something other than scientific truth and demonstrate how pandemics splinter and cleave, expose old hierarchies, and sometimes deepen distrust of traditional authorities and scientific experts.

Our current era of epidemics gives people much less reason to be sanguine about our ability to eliminate disease and pain, yet a key assumption remains. The natural world is separate from and at least in part controllable by humans, especially in its form of harmful germs and infectious diseases. Viewing matter and significance as inseparable in COVID-19, influenza, and other infectious diseases departs from old assumptions of bodily autonomy and the indivisibility of the individual. Seeing ourselves instead as 'dividuals' with a profound 'amongness' in the world puts us in an ethical quandary. We lose grasp of old and fleetingly comfortable ideas of medical progress that depend on controlling infectious diseases by destroying them, preventing them from reaching our bodies, or physically changing our bodies to become ever better warriors in our immunological battles against harmful germs. The best step, then, is to understand (1) that viral and bacterial natures are also human natures and (2) meaning-making is not confined to powers of observation but also derives from human social inheritances and interactions with each other. A new ethical obligation takes us from the illusive battlements and moats staving off contagion to an inartificial world in which nothing within or without escapes a radiant contagiousness.

The next section explores the entangled being of influenza using a historical method and a short case study from Brazil. The third section fits influenza within nature and culture, finding this to be an unrealistic dichotomy. The final section briefly considers the implications of a non-dualistic approach to epidemiological progress. What relationship should we have with pathogenic viruses and bacteria, especially as we live through the third modern era of epidemics and face global climate crises? If the old dichotomy of nature and culture has always been a mirage, how can we derive an ethic of better human existence and the world we co-inhabit? I suggest that Buddhist philosophy provides some good answers to these questions, such as recognizing the futility of locating, naming, enumerating, and then excising all (unknowable) threats that haunt existence. Realizing, living with, and releasing ourselves from (or to) suffering does not mean giving up the hope for new medical cures but understanding that illnesses come from ourselves as much as from the world around us.

Influenza in Brazilian History

In early 1891, Brazilians were struck by an unusual outbreak of disease. Scientists and government officials claimed influenza had arrived across the Atlantic from Europe. A newspaper in Rio de Janeiro called *O Pharol* (The Lighthouse) printed this exchange between a "jester and someone who thought he had the fashionable affliction":

> "What the hell are you doing?"
> "I think I'm sick from that influenza."
> "Seriously?"
> "Seriously."
> "Do you have vertigo?"
> "I have vertigo."
> "Do you have white patches on your tongue?"
> "Yes, white patches."
> "When you want to walk, do you feel your legs stumble?"
> "I feel that."
> "Well then, man, you're drunk!"[6]

Despite its satire, this account seriously engages in nosological debate. Nosology, or the system for naming and classifying diseases, has been done differently depending on the period and place. During Brazil's colonial period (1500–1822), the Portuguese commonly subscribed to Galen's old humoral classification system of blood, yellow bile, black bile, and phlegm. To Galen, whether a patient was feverish (involving blood and yellow bile) or phlegmatic determined the order of disease, but both could occur with influenza. Galen's system complemented Neo-Hippocratic environmentalism.[7] Hippocrates famously connected health and illness to places and climates, and this again became an area of active debate between the late 17th and mid-19th centuries.[8] A corrupted environment, as evident through bad smells and organic rot, could destabilize the bodily order, bringing together the ideas of these two ancient Greeks. By the middle of the 19th century, most Brazilian doctors had begun to abandon Galen and classify diseases by the part of the body that demonstrated the severest symptoms. Yet, they continued to stress the body's overall 'constitution' and fear the dangerous effects of 'miasmas', or the corrupted air, that prompted most diseases.

Brazilian doctors usually denied influenza's existence throughout most of the 19th century. The words *influenza* and *gripe*, common in Europe and North America, were rare in Brazil before the 1890s. When an outbreak of fever and cough struck Rio de Janeiro in 1835,[9] the city's most notable doctors convened a special commission to study "the epidemic of catarrhal fever that has been rampant in the first months of 1835". They drew comparisons to the 'gripe, or Influenza' described by 'ancient authors' and contemporary European doctors who witnessed an influenza epidemic on their continent between 1830 and 1832. The Rio commission came to no firm conclusions. The epidemic of 'catarrhal fever' in the nation's capital shared symptoms with European 'influenza', including inflammation and excessive mucus in the throat (catarrh), cough, headache, muscle pains, and, for some, fever and diarrhea. Most years in Brazil, catarrhal disorders corresponded with changes in seasons and winds and affected people of all ages, similarly to influenza in Europe. In contrast, the commission reported, "this resemblance is to some extent only; because besides attacking many more individuals at the same time [in Europe], the *grippe* always increases its symptoms at the local level similar to its effects across the general population; the opposite of what happened with this infection [in Rio de Janeiro]". In other words, 'catarrhal' symptoms appeared to differ more across the region's population, but they made no systematic survey. One-third of the 150 orphans living in the Santa Casa de Misericórdia Hospital of Rio de Janeiro had come down with cough, fever, and diarrhea in two weeks. Nevertheless, the commissioners dismissed the idea that the cause was the same as in Europe.[10]

Until the last decade of the 19th century, ‘influenza’ was a strange word to most Brazilians, including its governing elite. ‘Gripe’ seemed to some to be some French fad. In 1839, the newspaper *O Carapuceiro* (The Cap Maker) asked, “Why shouldn’t the ladies of today say, as their grandmothers did, we are with a catarrh, we have a cold (*defluxo*)? These old and dull terms will not serve a Lady of good style. [But] Gripe has a new expression, is fresh, and therefore more pleasing.” Sardonically, the newspaper added, “Even in sickness, there is a place for fashion.”[11] As their “grandmothers did”, Brazilian officials usually reported epidemics of catarrhs or bronchitis as nothing deserving the government’s concern. When recognized, influenza was a type of catarrh or symptom of bronchitis.[12] For instance, the Minister of the Interior described an epidemic of catarrhal fever “with symptoms that give it the character of the gripe” in Rio de Janeiro in 1864 and an epidemic “of gripe” in the far northern state of Pará in 1876, but these were exceptions.[13]

This composition of illness and recognition changed in 1891, soon after European doctors widely recognized that influenza had spread across Eurasia before leaping the North Atlantic. A new ‘catarrhal fever’ epidemic appeared in Rio de Janeiro and Bahia that same year. Again, commissions of doctors assembled within each of the major cities affected. During the first month, the commissioners of Rio de Janeiro and Bahia rejected the diagnosis of ‘influenza’, but they began to change their minds by the second month when thousands more sickened with telltale symptoms.[14] I believe this was the first time officials reported influenza spreading from port cities into the interior and adjacent states across Brazil. Influenza outbreaks were recognized in Minas Gerais, Pernambuco, and Sergipe. Yet, unlike in Europe and other parts of the world affected by this pandemic, the mortality rate from flu, at least in Brazil’s biggest cities and its southeastern interior, was reported as very low. Nina Rodrigues, known today for his pioneering research on medical anthropology, claimed that after influenza had sickened hundreds in his city, he counted only six deaths.[15] Still, the diagnosis of ‘influenza’ stuck, and doctors assigned it more commonly after this epidemic. Many others besides Rodrigues continued to believe Brazil’s tropical climate tempered the virulence of diseases that originated from cold places. This belief stubbornly persisted and was implied in 2020 when Jair Bolsonaro, Brazil’s former president, soft-pedaled COVID-19 as just a “little flu” (*gripezinha*).

During the 1890–92 epidemic, was influenza discovered, recognized, or invented in Brazil? Historians have debated whether diseases we know today could have existed in the past and before their recognition. Mark Honigsbaum has argued that the “notion of ‘scientific facts’ independent of social processes is highly problematic”. He adds:

> Science, like other forms of knowledge production, is subject to continual paradigm shifts. Even allowing for the ontological possibility that there may be such a thing as influenza with essential and unchanging biological qualities and attributes, neither influenza nor any other disease can stand outside of the epistemological and social frameworks that produce it. The present, in other words, is no more ‘knowable’ than the past.[16]

To put it another way, to partake in ‘retrospective diagnosis’, in which we insist that influenza must have caused epidemics that Brazilians misdiagnosed before 1890, is to practice a kind of ‘Whiggish’ history in which influenza is known in a way that it could not be in the past.

Our contemporary ‘epistemological and social framework’ also allows us to see how the very notion of influenza emerged among transatlantic medical experts who relayed their messages of the 1890–92 pandemic within a newly globalized news media landscape. Without the capability of cheap print, railroads, and telegraphs to move information rapidly around the world, what became known as the ‘Russian flu’ would not have transformed, as Honigsbaum insightfully writes, “from a scientific curiosity with transitory health and social impacts into a mass media phenomenon with a cause of sensation and dread”.[17] Indeed, a feeling of dread has marked many subsequent influenza pandemics and scares. The 1918–19 global pandemic frightened most people with its risks and deadly effects. That pandemic may have infected one-third of the world’s population while killing tens of millions.[18] National and international media outlets have sensationalized more recent pandemics of influenza, including the 1957–58 ‘Asian flu’, 1968–69 ‘Hong Kong Flu’, and 2009 ‘Swine Flu’ (popularly considered ‘Mexican’). All were deadly episodes but never became the global calamity against which journalists and government officials had warned. Nevertheless, they linked easily with prevalent anti-Asian, xenophobic, and religiously discriminatory beliefs worldwide.

New forms of social panic accompany new forms of communication. In the early 1890s, an amazing new device called the telegraph connected Brazil’s major cities. Railroads linked ports with the interior’s agricultural areas, and steamships carried passengers and news quickly between them. Daily newspapers had proliferated so that its largest cities had 10 or 20 regular publications, and nearly every large town had at least one newspaper. Brazilians were more aware of what was happening in their nation, and many literate people closely followed news from around the world. The consequences were sensational. For example, on February 3, 1892, the *Pharol* reported:

> The news received from other countries reveals the development of this disease [influenza] everywhere. In Australia, she has made rapid progress in these last days. In Bohemia, the affliction rages with intensity in the insane asylums. In Copenhagen, 50,000 people have been infected in a city with 300,000 inhabitants. Some cases have been fulminant! The movement of carriages is almost paralyzed since disease especially infects the coachmen, certainly because they are always exposed to the rigors of the weather.[19]

Brazilians had read reports of a distant tragedy caused by something also lurking in their miasmatic air before, but it is remarkable how quickly they received the news of the pandemic from distant places by 1891. Some may have continued to joke about the disease in style, but this humor hid a new dread about an entirely new disease or, at least, an old disease that now risked a total assault on humanity. No longer were Brazilians confronting their grandmother's catarrhs. Instead, we find influenza within common beliefs molded by the social and technological settings of the specific period.

Influenza's recognition and transformation in Brazil and its insertion into a globally calamitous event depended on complex processes that entangled matter and significance. Its existence in Brazil and the fear that preceded infection in 1890 were only possible with rapidly disseminated information from Europe and other parts of the world. Quick, global, and mass communication depended on new technologies and mechanisms. The 1890 pandemic took advantage of the same technology that disseminated the news. Influenza was reported to have ridden the rails and crossed the ocean by steamship but "has not travelled faster than human beings, parcels or letters could travel", according to a contemporary study of the pandemic's causes.[20]

At the end of the 19th century, we can point to how Barclay offset cylinders transferred print for cheap daily newspapers, and coke pushed steam through the rotating pistons to drive massive locomotive trains. Electrical currents deflected tiny, magnetized needles to transmit telegraphic messages across long distances. People interacted with and operated these collections of objects and materials in a particular way that we can no longer observe or absolutely confirm. For example, Emile Baudot revolutionized the telegraph in 1874 with a five-bit code that served as the predecessor to the ASCII or Unicode. The computer I use to write this article has inherited a form of that code. But unlike my ‘QWERTY’ keyboard, the 1874 Baudot telegraph had just five keys arranged in a piano-like fashion. Its operators pressed combinations of the keys to designate alphabetic characters, numbers, and symbols. The device required great practice and skill; its experts were like maestro musicians because the telegraph only worked steadily and in synchronicity with devices and their human operators receiving the message.[21] Through its telegraphers, electromagnets, printing tape, underwater oceanic cables, and many other interacting parts, the Baudot telegraph permitted officials in St Petersburg to tell Londoners, and Londoners to tell *Cariocas* (residents of Rio de Janeiro) of a terrible influenza outbreak in their city in 1889.

Millions of people worldwide whose perceptions of influenza altered with global communication never witnessed these media devices in action. Furthermore, the physics of the electromagnetism of the telegraph and the chemicals of the printing ink were understood differently from the way we understand them today, yet we assume they still ‘worked’ to transmit physical messages. New technologies accompanied new modes of transmission carrying both the disease itself and frightening ideas of the disease, but it was not a simple process of cause and effect as these new forms were equally material and signified. For example, in Figure 1, we can compare the Cable-Morse and gel electrophoresis codes used to send communications and make meaning. This figure places one communication code used to report the 1890–92 pandemic globally next to another code that scientists began using in the 1950s to distinguish the re-assortment of influenza at the genetic level. Despite their visual likeness, these two vastly different coding systems operated almost a century apart. Nonetheless, they share three important features when considering how matter and significance are perpetually entangled.

First, Cable-Morse and gel electrophoresis use codes to interpret other codes. To put it another way, each uses its own unique language to relay another. The Cable-Morse, as we have seen, helped spread the alarming news of influenza in French, English, and Portuguese. The genius of Morse code is that it defined a way of sending sequential voltage or current pulses in patterns that represented letters, numbers, and punctuation. Stretching a long wire between two poles and running

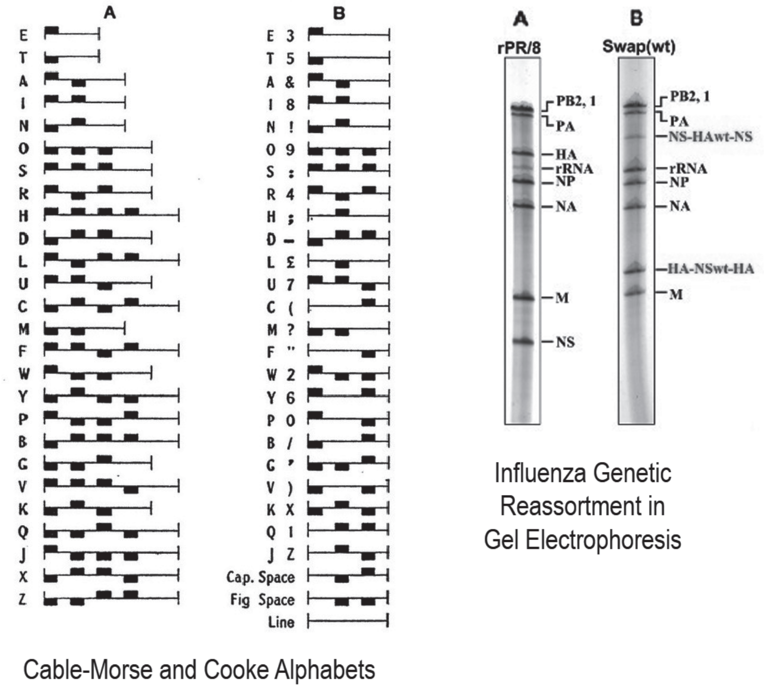

Figure 1. Cable-Morse and Cooke alphabets used for telegraphy compared to influenza genetic reassortment examined by gel electrophoresis.

an electrical current from one end to another still leaves you a long way from a meaningful communication. However, gel electrophoresis also relies on an electrical current that runs through an organic sample suspended in an agar gel, leaving a kind of genetic fingerprint or shadow. Morse and gel electrophoresis use an alphabetic code. The letters for geneticists give meaning and measurement to genetic shifts in influenza and other viruses.[22] It creates a record of how a particular strain of influenza diverges from others through genetic mutation. For these two technologies, each stage of the translation process depends on manipulated and embodied tools that turn their handlers into points of reception and transmission. No one had imagined gel electrophoresis when the 1890–91 flu pandemic struck, but this does not mean that influenza's rapid mutation was any different before we developed a tool to observe and codify genetic mutation. Most likely, influenza genetically mutated in the late 1880s and then again in the early 1890s, accidentally increasing and then decreasing its virulence among people. Epidemiologists posit that pigs are ideal mixing vessels because of their ability to harbor deadly strains of flu in and among birds and humans.[23]

The new genetic combinations can be hazardous because the strain is unlikely to resemble those that existed before, providing little familiarity for the human immune system. The 1890–92 global pandemic of influenza was the most mortal until the 'Spanish' flu epidemic of 1918.

A second shared feature is how the Cable-Morse and gel electrophoresis are communicative instruments manipulated by hand by experts who translate almost entirely out of sight of most people affected by the messages they transmit. The telegraph worked through an electronic transformation of dots and dashes, or combinations of 'dits' and 'dahs', to copy a message written and stamped on ink on two sides of the Atlantic. Gel electrophoresis is also handy, if mostly out of sight. When scientists in various laboratories around the world pull the DNA of a mutated virus through the gel by the electric current, a dye that binds to the DNA leaves a slight trace that looks like a band. They may detect influenza's genetic shifts, even mutations caused by exchanges over immense distances, such as in the bloodstream of wild fowl migrating between continents.

A third important similarity is how these two systems formed multi-directional loops of significance through assemblages of manipulated matter and expert handlers. During the 1968 influenza pandemic, a few Brazilian scientists used gel electrophoresis to track the virus's mutations. Many more Brazilians listened to the threat of this disease from national and international experts with new forms of communicative technologies like television and satellites. International networks of interacting and communicating objects came together in ways different than in 1890, yet fear became contagious through these many devices and their codes. In 1968, enough people remembered the telegraphed devastation caused by the 1918–19 pandemic to heighten the sense of a threat that seemed fated to occur exactly 50 years later. Radios and televisions screamed their frightening warnings this time. Influenza deaths increased only within Brasília, the nation's new capital. The rest of the country saw little increase in influenza mortality that year for reasons unknown.[24] In this example, we see how influenza is altered through a temporal sequence of events, but also by feedback loops, such that the disease is imbued with more or less power depending on collective memories and shared experiences among communities.

The Cable-Morse and the gel electrophoresis coding systems were invented and used most actively at different periods, but they are not entirely separated by form or time. They both layered referents, subjects, and objects in overlapping and embodied relationships. These embodied relationships teach us how an epidemic disease became something that it was not before through the multilayered and trans-historical operations of objective and subjective coding systems. Their recognition also allows us to move past concerns about using epidemiology in the past (i.e., 'retro-diagnosis'), such as posited by Honigsbaum. As we have seen, thousands of objects and materials, from telegraphs to the nucleotides of influenza RNA, interacted and operated in ways mostly out of sight. We can only assume they were the same or similar to how we understand these to interact and operate today.

We may creatively frame diseases by their unique social and cultural context at a particular moment in time. Still, a disease may also escape the picture and encompass the frame. Separating the cultural from the environmental or natural replicates an old dichotomy that people do the building and constructing, whether materially or discursively, while nature, lurking out there somewhere, does the evolving and adapting. Instead, as we see with influenza and other epidemic diseases, matter and significance shift in interdependent and complicated ways. Therefore, a microbe did not 'just' genetically mutate from a catarrh into influenza. Nor did Europeans and Brazilians 'just' discover or invent the tools to transform our perception of locally transmitted catarrhs into a new and globally significant pandemic disease called influenza. The best way to explain how these things occurred simultaneously is to see (1) the disease as assuming a new form, (2) this form fitting a new perception of the disease through multilayered coding systems, and (3) form and fit coming together with many of the same human and non-human material assemblages and tools. For a peg to fit a hole of slightly greater average diameter, it must have the same shape. Such fit does not depend on whether the peg or hole was shaped first. Influenza must be discernable to be discerned, and discerned to be discernable. In a broader sense, humans must be authored to be authors, and authors to be authored.

The following section approaches influenza in biology, chemistry, and ecology, yet even in these 'physical' fields, we find polyvalence and poly-ascription that mix matter and significance.

Influenza in Matter and Significance

Influenza's 'fit' is always within and between nature and culture. In this section, I turn to the natural sciences to extend the argument. Influenza and other pathogenic microorganisms are presented less as having a discrete relationship with human bodies and more as having the same substance and being. This approach requires confronting two other dichotomies: (1) life and non-life and (2) harmful and harmless germs. Following this section, I conclude with a discussion of how we may find ethical obligation and action without having to evaluate and measure human capacity and progress by total prevention, elimination, and control of epidemic diseases. I call for an 'entangled epidemiology' whose ethical goals may best lie in Buddhist philosophies.

Separating the living from the nonliving gives us the illusion that we may easily distinguish agency 'out there' in nature and a similar kind of agency 'within us' via culture and ideology. These dichotomies run parallel, especially when it comes to metaphorically framing epidemic diseases as a kind of enemy agent that deserves our wrath and destruction. Yet, placing the pathogenic organisms and humans in the same category of life and agency wrongly understands microorganisms and people. Influenza's 'cultural physicality' or 'physical-cultural shape' is apparent in three ways.

First the virus's tiny size and structure aid its remarkable shapeshifting. Influenza's virion is a spiked sphere 80 to 120 nanometers in diameter, extraordinarily small considering a pencil's lead is about one million nanometers larger. In such a tiny space, the virion's structure is relatively simple relative to most organisms. Lipid membranes and proteins envelop its genetic material, but influenza has no nucleus, mitochondria, or ribosomes. When replicating, influenza viruses demonstrate antigenic drift or relatively rapid accumulation of mutations. This drift makes it a master of metamorphosis, and the many organisms that survive an infection become no more resistant after recovery. Humans also cannot adapt quickly enough to influenza, forcing government agencies and large pharmaceutical companies to constantly re-engineer influenza vaccines. Furthermore, influenza and other viruses depend on living cells to replicate, but as a retrovirus, influenza's structure and functions distinguish it from more 'stable' DNA viruses that copy themselves much more consistently because of their double-stranded genome.

Second, the virus shapeshifts, thereby gaining or losing its ability to function, through assemblage, dissemblage, and exchange of basic elements. These same elements also assemble to permit our bodies to observe the virus, feel sick, or catapult it into the air by coughing. Influenza viruses replicate by 'tricking' host cells into providing the virion with a protective membrane and a kind of conveyer belt straight to the cell's nucleus. As it moves into the cell, it transforms, allowing it to invade the cell's nucleus and hijack the functioning of the cell. The cell then makes copies of influenza's RNA before bursting open to release new viruses. White blood cells scavenge the remaining carbohydrates and proteins of the dead, exploded cells, reusing them for living cells. In influenza's replication, its destruction by white blood cells, or the pieces of virally exploded cells, essential molecules and their compounds move from one sphere to another. Some of what moves are the remnants of the nucleic acids that make up DNA and RNA. These are composed chiefly of carbon, hydrogen, and oxygen, the three elements that make up all simple carbohydrates, including those that bind with other compounds or link together in long chains to form the structure of most organic material. Carbon, hydrogen, and oxygen circulate in the orb of our craniums and the orb of our stratosphere. In their combinations, carbohydrates compose the source and storage of energy for life and viral replication. The way we feel when we are sick with flu or how we see the sky as blue results partly from an electrophysiological process that activates retinal circuitries or signals from the peripheral nervous system to process in the cerebral cortex.

Suppose we follow the many links from the oxygen in our atmosphere and blue skies, to the carbon in our blue veins, to the nitrogen in the grey microbial boarders of our guts, to the recycling of carbohydrates contained by the organic and opportunistic struggle between influenza and our immune system. We cannot be anything but thoroughly embodied with and by influenza's physical-cultural shape. This embodiment escapes the boundaries of what is living, as we can see when influenza enters the body through the respiratory tract. We involuntarily catapult trillions of influenza viruses in the air through our sneezes when axons or nerve fibers fire electrical impulses, signaling neurons, muscles, and glands. All parts of the neuron, including axons, dendrites, and Schwann cells, have specific chemical compositions that are absorbed or released in their generation or degeneration. We need these for thinking, communicating, and doing. The one and a half kilograms of tissue of an adult brain connect with about 45 miles of nerves that wind in a root-like pattern between our ear flaps, pulmonary arteries, and little toes. Recently, scientists reported evidence that the brains of healthy humans and monkeys may provide habitations for alpha-proteobacteria, a diverse class of microbes not commonly found in other parts of the body, that may interact with bacteria in our guts and help serve our brains' operations.[25] It is too early to tell if there is a 'brain microbiome', but there is little doubt that without microorganisms we would not be human. To conceive of our microbiomes or make sense of this sentence, we must escape our heads and interact with a striking combination of organs and organisms.

A third cultural physicality of influenza is how it lurks in the twilight zone between life and death. As a virus, most biologists do not consider influenza to be alive, but few scientists dwell on the fact that things that are more or less 'alive' may shift in different contexts, over time, and with new beliefs. We usually hold life and death to be two dichotomous conditions in the modern West (yet painfully confronting a blurry division at critical moments).[26] Comparative ethnographies have long demonstrated that strict divisions between a 'natural' and 'unnatural' world are often less evident beyond the Judeo-Christian West. Most people in the world have made fewer distinctions or assigned different characteristics to living, non-living, human-created, and non-human-created things. Consider collective and socially reproduced and ritualized beliefs involving animism, analogism, anthropomorphism, totemism, and theomorphism. Far from being exotic or primitive beliefs, nearly all wars and atrocities involved aweless dehumanization, especially between the United States and Japan in the middle of the 20th century. Neuroscience, biology, anthropology, and popular beliefs better demonstrate cultural-natural hybridity than a world stamped out of our familiar but unrealistic Cartesian dualisms.

For most microbiologists, the hundreds of thousands of different species, serogroups, and biotypes within the viral taxonomy are not alive. Like other organisms, viruses carry their reproductive faculties within their genes, but they are obligate intracellular parasites because they have no nuclei or cell walls and depend on cellular organisms to replicate. Nevertheless, all organisms are 'obligate' in some way within their niches (e.g., aerobes), and a vast number are 'parasitic', if that means a non-mutual transformation of the energy of host organisms for the continuation of their lodgers' lives. Plasmids and prions, such as the misfolded proteins of Creutzfeldt-Jakob disease, provide more evidence of the expansive grey zone between life and death within which microorganisms and other particles operate.[27] Bacteria, viruses, and other organisms can enter into highly dormant or viable but nonculturable (VBNC) states by enveloping themselves in durable material (e.g., biofilms and endospores). Tetanus, or 'lockjaw', was a common endemic disease in Brazil and worldwide until the 20th century. Its bacteria, *Clostridium tetani*, can persist in an endosporic state for millennia, sometimes buried deep within the soil. In these transitional periods, are such organisms alive or dead? For most microbiologists, we do not need to define the line between life and non-life to understand how organisms and their essential components enter into complex interactions to exchange energy, mutate, and pass on data for reproduction.

Yet this question of life matters for explaining epidemics because their tragedy is less an assault by one living, willful organism upon humans and more a reconfiguration of a vast number of things and part of regular exchanges of matter in a recycling world. Consider another analogy. When a person is murdered by poison, we do not pin blame on the self-action of the poison, we seek the poisoner. Influenza, misfolded proteins, and endospores are neither poisons nor poisoners; yet we may best accept them as among the whole of ourselves whether prevented or not.

We may have as much trouble drawing a sharp line between what is alive and what is dead as between what is natural and what is cultural. Clearly, there is little debate when we compare our tail-wagging family dog to a garden stone, but we are surrounded by and serve as mobile vessels for an enormous mass of the most minuscule things that function as they do because they straddle life and non-life. Dualities can be convenient and comforting, but they do not help us understand how and why diseases became fearsome epidemics.

Another comforting but artificial dichotomy separates harmful from harmless germs. In some important ways, humans are not unique and solitary but composite organisms that blend into the world. In their living state, composite organisms are multicellular, homeostatic soma composed of smaller organisms upon which they depend for their composition and life. Composites have properties that might be distinguished from the properties of their component organisms, although these lines are often blurred. Lichens are a classic example because they grow when algae and cyanobacteria reproduce among the filaments of a fungus in a mutually beneficial way.[28] Humans are not too different from lichens: for every single cell of the human body, there are about 10 microorganisms (weighing several pounds if removed from an average adult!). Our microbiomes help us digest our food, ward off pathogens, live in our teeth and guts, and probably influence our moods. We share, renew, or weaken our microbiomes within our immediate and intimate environment, especially through contact with the people and animals we live, eat, and sleep with in our modern niches.

Commensal (mutually beneficial) and pathogenic (causing or capable of causing physical pain, disability, and death) microbes, and many others that neither benefit nor harm us enter mostly through our mouths and noses. They can also come in through our genitourinary system or broken skin. Although we are hardly aware of our microbial environment unless we catch the flu or a cut becomes infected, it is no less than a jungle. Hundreds of species of microbes seek to reproduce on every surface we touch and nearly everything we eat. Also, countless numbers float in invisible, miasma-like clouds, drifting in and out of our lungs with every breath. This way, we exchange microbes with strangers and many more with our loved ones.[29] The microbiota of families and close-knit communities show common characteristics, a kind of family gut fingerprint. If the microbiota is a crucial organ — and this may be the best way of seeing it — it winds itself through our homes, classrooms, and workplaces, and has for a very long time. Host organisms and lodging microorganisms coevolve. Humans' best evolutionary trick (although hardly unique) may be to provide an ideal breeding ground through regulated temperature, acidity, and nutrients for microbes that bestow upon us vitality and protection to thrive. This is a handy trick because most microbes, and especially RNA viruses, evolve much quicker than multicellular organisms. While dangerous strains of influenza virus can assume new forms several times each year, one of our best defenses against pathogens may be our own rapidly evolving commensals.

The microbe exploits opportunity when it sickens, as influenza did in Brazil in 1891. Zealous opportunism is a characteristic of microbes that take advantage of new mutations, pathways, and environments to self-replicate and signal. Opportunities exploited by pathogenic microorganisms may reduce opportunities for some of their hosts, while the opposite is true of commensal microorganisms. Of course, humans are also zealously opportunistic and take advantage of new 'mutations' (via tools and technologies), pathways, and environments. The best opportunities for the deadliest pathogenic diseases have occurred when tools and technology dramatically altered how people moved and lived, demonstrating human/ microbial coevolution. Diseases transmitted by airborne particles (influenza, smallpox, measles, tuberculosis) probably did not emerge until about 12,000 years ago, when people adopted sedentary lives and surrounded themselves with domesticated animals with whom they traded diseases. Farming settlements that encroached on insect habitats facilitated arthropod vector diseases such as malaria. 'Crowd diseases' such as plague, typhus, and cholera did not become severe until small settlements grew into cities with sufficient population densities and trading contacts.[30] The world saw its first true pandemic (epidemic on a global scale) only after fortune hunters, settlers, and enslaved people began crossing the Atlantic and Pacific Oceans. Today, ships and airplanes continue to push the boundaries of diseases on an intercontinental scale. West Nile, Chikungunya, dengue, and Zika viruses have emerged or reemerged in the Americas in part because of interoceanic shipping, ever more significant movements of people, and opportunistic mosquitos. Therefore, we must consider the changing relationship of microbes, vectors, and people as the meeting of entangled opportunism at the micro and macro levels. Evolutionary mutation among microbes coincides with the technological evolution of people, for the better or worse. In other words, epidemics may be defined as moments of entangled opportunism.

In sum, I have examined how two binaries demonstrate no sharp edges, concluding there may be no stable or independent state of 'nature' or 'culture'. One cannot wholly precondition or frame the other. Furthermore, we can more easily distinguish life and death among organisms of visible size, but to understand disease ecologies, the 'in-betweenness' of life is more helpful. We cannot understand microbial pathogenicity without microbial commensality. The final section concludes by discarding other unhelpful dichotomies (life/ non-life, harmful/ harmless germs, healthy/ ill) to bring us an ethics of epidemiology best rooted in the relational and radiant ontology of Buddhist belief.

Epidemiology of Creative Coexistence and Interdependence

In the face of all this blurring and blending, how can we pursue a humanistic effort to diminish the harm of epidemic diseases? As argued in the last two sections, organisms are locked within interdependent exchanges of matter and significance. What should be our goals, especially in the wake of such tragedy as wrought by COVID-19? A non-dichotomous approach would necessarily abandon the view that human intelligence and design (via ideology and culture) should ultimately control or dominate nature. The old and common view of germs as our 'foes' also attempts to separate the inseparable. There are many instances, like a surgeon's glove, where microorganisms must be eliminated as much as possible, but a 'war' with microorganisms is a war upon ourselves, inviting unending dissatisfaction. What then is our obligation?

As we have seen, deep relations matter. Buddhist philosophy, especially its relational ontology, may provide the best answer. The first section of this essay relied on a historical method to describe how influenza was both discovered and invented in Brazil in the 1890s. The virus probably mutated, but so did the 'tools' that (1) harnessed its movement across the world and (2) changed how people in distant lands came to recognize and understand the disease. Understanding comes as a matter of 'fit' among these non-discrete parts. The second section discussed biological, chemical, and ecological methods. These also find no solid line among old and comfortable dichotomies foundational to how we understand and try to control epidemic diseases. In the past and present, the influenza virus, pigs, fowl, humans, and many other things and beings were in such perpetual interdependence that a stable discretion of their forms is ultimately impossible. Influenza may be transmitted within webs of collectivity that condition their arising and dissolving.[31] This idea may have once existed more than it does today, as influenza has its origins in the Latin word *influere* or 'to flow into, stream in, pour in'.

The deep relations that define Buddhist ontology also provide an ethical stance. A nondualist conception of 'self' and 'nature' is crucial to several doctrinal traditions in Japanese Buddhism, but perhaps most in Nichiren Buddhism. According to Steve Odin, Nichiren "was equally concerned with the relation of the individual to both the social and natural environment".[32] In this way, the principle of *esho funi* articulates the unity of self and nature and the oneness of life and its environment. *Esho funi* insists on a profoundly ecological notion of personhood, Odin writes, "which at once constitutes the doctrinal basis for an environmental ethics".[33]

Esho funi also provides an epidemiological ethics, one that values the collective benefits of the influenza vaccine over an individual success rate. For example, the 2000-year-old Mahāyāna Mahāparinirvāṇa Sūtra provides a helpful parable on health and its illusions. It describes a mythical plant that grows on the edge of a precipice covered with tall grass. When eaten, the plant gives 1000 years of life. Some people who 'greedily covet the taste' forget the deep pit in their haste, slip, and fall off the edge to their death. "But the wise know how things stand; they do not come near."[34] An influenza vaccine is not the fabled ambrosia; it is a tool of collective responsibility that proves our social and physical interdependence. In contrast, the ambrosia of the Mahāyāna Mahāparinirvāṇa Sūtra is a deceptive balm for the human ego.

The influenza vaccine has reduced the risk of severe disease among the US population by 10 to 60 percent each year since 2004.[35] Receiving the tiny jab of the influenza vaccine may be like taking a step to prevent one's body from falling. This analogy was explored in a famous dialogue between Daisaku Ikeda and Guy Bourgeault, a professor of education and bioethics. They likened health to walking, in which we must risk losing our balance by leaning our body in a particular direction to walk. A footstep momentarily restores the balance before we lean again to maintain our precarious momentum. This ‘dynamic of effort and tension’ can be compared to the dynamism of health, in that “it is always threatened, and that we can never take it for granted. Above all, it is never complete and whole, that is, it is never perfect”.[36] In years when the influenza vaccine was inadequate, our ‘walk’ in the face of this disease carried more risk of tripping and falling. Nevertheless, the collective body may also ‘walk’ through its collective health, and still walks better when influenza’s vaccine has higher efficacy.

Since risk can only be reduced in certain moments and always temporarily, Drs Ikeda and Bourgeault recommended treating illness as a part of health, not its opposite. In this way, they lead us to the final unhelpful dichotomy of the article: illness/ good health. The Vimalakīrti Sūtra also illustrates a nondualist approach to health. Vimalakīrti was a lay believer who was ‘sick’ because other people were sick. By recognizing the suffering around him and releasing himself of the illusion that contentment could come from some absolute absence of disease and pain, Vimalakīrti was moved from his inward focus to an outward and immense empathy for others. Vimalakīrti attained what Daisaku Ikeda has called a ‘broader equilibrium’ enabled when “the very process of overcoming illness tempers body and mind”.[37]

Like the fabled ambrosia, no vaccine, medicine, or tool we may invent can stave off the inevitable, entirely remove suffering, or end ‘contagion’ in a world of contagious relations. We need a different ethics when the influenza and human organisms operate only through our embodied ‘among-ness’. It must be an ethics of health that rests less on defending against dangerous externalities, and more on finding balance and perspective within and among our commingling world. Health comes not just from without — like alien dangers — but also within and especially among. Joyful health and painful sickness are bound together as temporary states over which ‘control’ may be best achieved by recognizing that control is illusive. Binding health and illness together provides a “unifying vision of health” and “illustrates the links that tie each individual to the suffering of others, creating a radiant picture of human health”, as Dr Ikeda has written.[38] In the face of epidemics that splinter and cleave, radiance may be the best remedy.

Notes

1 United Nations, ‘Secretary-General Denounces “Tsunami” of Xenophobia Unleashed amid COVID-19, Calling for All-Out Effort against Hate Speech’, Secretary-General Press Release, accessed October 16, 2022, https://press.un.org/en/2020/sgsm20076.doc.htm.

[2] René J. Dubos, *Mirage of Health: Utopias, Progress, and Biological Change* (New Brunswick: Rutgers University Press, 1987 [1959]), 157.

[3] UNADIS, 'Global HIV & AIDS Statistics — Fact Sheet', accessed October 16, 2022, https://www.unaids.org/en/resources/fact-sheet.

[4] Andrea Patterson and Ian Read, *The Shapes of Epidemics and Global Diseases* (Cambridge: Cambridge Scholars Publishing, 2020).

[5] Joel O. Wertheim, et al., 'A Case for the Ancient Origin of Coronaviruses', *Journal of Virology* 87, no. 12 (June 2013): 7039–45. https://doi.org/10.1128/JVI.03273-12.

[6] *O Pharol* [Juiz da Fora, MG], February 15, 1890, 1.

[7] William Bynum, *The History of Medicine: A Very Short Introduction* (Oxford: Oxford University Press, 2008), 6–11.

[8] David Cantor, ed., *Reinventing Hippocrates — The History of Medicine in Context* (Aldershot: Ashgate, 2002).

[9] 'Relatório da comissão especial sobre a febre catarral que grassou nos primeiros meses de 1835', redator: Emílio Maia, *Revista Médica Fluminense*, 10–17(Jan 1836).

[10] Ibid.

[11] *O Carapuceiro*, February 13, 1839, 3.

[12] 'Catarrhal fever' was also often assigned to bronchitis in the English-speaking world. See, for example, William Stokes and John Bell, *Lectures on the Theory and Practice of Physic* (vol. 2) (Philadelphia: Ed. Barrington & Geo. D. Haswell, 1842), 168–94.

[13] Jose Pereira Rego, 'Relatorio do presidente da junta central de hygiene publica', *Relatorio apresentado a assemblea gera legislativa* [Annual Report of the Minister of the Empire] 6 (Rio de Janeiro: Typographia Nacional, 1865); Junta Central de Hygiene Publica, 'Relatorio do presidente apresentado em 1876', in *Relatorio apresentado a assemblea gera legislativa* [Annual Report of the Minister of the Empire] 36 (Rio de Janeiro: Typographia Nacional, 1865). Rego counted a number of epidemics of 'catarrhal fever' between 1830 and 1870 in Rio de Janeiro. See *Esboço historico das epidemias que tem grassado na cidade do Rio de Janeiro desde 1830 a 1870* (Rio de Janeiro: Typographia nacional, 1872).

[14] See, for example, *Annuario demographico*, São Paulo (Brazil: State, 1900).

[15] Nina Rodrigues, 'A epidemia de influenza na Bahia em 1890', *Gazeta Medica da Bahia*, vol. 22 (Bahia: Litho-Typographia de Joao Gonacalves Tourino, 1891), 548–57.

[16] Mark Honigsbaum, *A History of the Great Influenza Pandemics: Death, Panic and Hysteria, 1830–1920* (London: I.B. Tauris, 2014), 15.

[17] Ibid.

[18] In Brazil, the pandemic killed 266,000–587,000 people. This figure was much higher than the government and subsequent historians have reported. Aldo Musacchio and Ian Read, 'Influenza Pandemics in Brazilian History', in *História, Ciências, Saúde — Manguinhos* (Forthcoming, vol. 29, no. 4, Oct.–Dec., 2022).

[19] *O Pharol*, February 3, 1892, 1.

[20] H. Franklin Parsons, *Report on the Influenza Epidemic of 1889–90* (London: Byre and Spottiswoode, 1891), 52.

[21] Colette Colligan and Margaret Linley, *Media, Technology, and Literature in the Nineteenth Century: Image, Sound, Touch* (London: Routledge, 2016), 164–67.

[22] Vincent Racaniello, 'Virology Question of the Week: Why a Segmented Viral Genome?' Virology Blog, About Viruses and Viral Diseases, accessed June 15, 2022, http://www.virology.ws/tag/reassortment/; Donald Murray, 'Setting Type by Telegraph', in *Journal of the Society of Telegraph Engineers*, vol. 34 (London: E. and F.N. Spon, 1904–05), 586.

[23] Jonathan Van-Tam and Chloe Sellwood, *Pandemic Influenza* (Wallingford, Oxfordshire: CABI, 2013), 18.

[24] Musacchio and Read, 'Influenza Pandemics in Brazilian History'.

[25] W.G. Branton et al., "Brain Microbial Populations in HIV/ AIDS: α-Proteobacteria Predominate Independent of Host Immune Status', *PLoS One* 8 (2013), http://journals.plos.org/plosone/article?id=10.1371/journal.pone.0054673. Link CD. 'Is There a Brain Microbiome?' *Neuroscience Insights* 16 (2021), https://journals.sagepub.com/doi/epub/10.1177/26331055211018709.

[26] Terri Schiavo's beating heart and inactive mind demonstrated how a person who is medically defined as having a 'persistent' or 'permanent vegetative state' may be vitally alive to some, but unquestionably dead to others. Schiavo fell into a prolonged coma in 1990 and was classified as being in a persistent vegetative state. In 1998, Schiavo's husband petitioned the courts to remove her feeding tube as a 'right-to-die' legal case. As the case wound its way up to a federal district court, it attracted considerable attention from the media and activist groups. President George W. Bush signed legislation to keep her alive in 2005, but a federal appeals court upheld the original decision and Schiavo's hospice removed her feeding tube, leading to her death that year. University of Miami Ethics Programs, 'Terri Schiavo Case Resources', accessed June 15, 2022, https://bioethics.miami.edu/clinical-and-research-ethics/terri-schiavo-project/index.html.

[27] Plasmids are like viruses because they have no nuclei or cell walls but can self-replicate through the genetic programming they convey. Microbiologists consider plasmids to be neither organisms nor alive because these small 'particles' separate from their host organisms (bacterial, archaea, or eukaryotes) in order to insert DNA into the genes of other hosts through lateral transfers. Microbiologists call viruses that infect bacteria bacteriophages, but some bacteria display impressive survival techniques through mutation that involves a process of viral infection called the lysogenic cycle.

[28] Steven L. Stephenson, *The Kingdom Fungi: The Biology of Mushrooms, Molds, and Lichens* (Portland: Timber Press, 2010).

[29] Katrina Ray, 'Married to Our Gut Microbiota', *Nature Reviews Gastroenterology & Hepatology* 9 (2012): 555.

[30] William Hardy McNeill, *Plagues and Peoples* (New York: Anchor Press, 1976).

[31] Gerhard von Klünger, *Buddhism — Science and Medicine* (Nordhausen: Traugott Bautz, 2015), 15, accessed July 15, 2022, https://search.ebscohost.com/login.aspx?direct=true&AuthType=ip,shib&db=nlebk&AN=1092443&site=ehost-live.

[32] Steve Odin, *The Social Self in Zen and American Pragmatism* (Albany: State University of New York Press, 1996), 393.

[33] Ibid., 394.

[34] Tony Page and Kosho Yamamoto, *The Mahayana Mahaparinirvana Sutra* (London: Nirvana, 2007), 102, http://lirs.ru/do/Mahaparinirvana_Sutra,Yamamoto,Page,2007.pdf.

[35] 'Past Seasons Vaccine Effectiveness Estimates', Centers for Disease Control and

Prevention, National Center for Immunization and Respiratory Diseases, last modified August 26, 2021, https://www.cdc.gov/flu/vaccines-work/past-seasons-estimates.html.

[36] Daisaku Ikeda, René Simard, and Guy Bourgeault, *On Being Human: Where Ethics, Medicine and Spirituality Converge*, new edition [online] (Montréal: Presses de l'Université de Montréal, 2002). Retrieved from http://books.openedition.org/pum/14901.

[37] Ibid., https://books.openedition.org/pum/14915.

[38] Daisaku Ikeda, René Simard, and Guy Bourgeault, *On Being Human: Where Ethics, Medicine and Spirituality Converge* (Santa Monica, CA: Middleway Press, 2003), 86.

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