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Siren Song: A Pathography of Influenza and Global Public Health

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Siren Song: A Pathography of Influenza and Global Public Health

by

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Professor Xin Liu, Chair

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Abstract

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This dissertation analyzes the various scientific, political and cultural narratives about and the official public health responses to the recent 2009 H1N1 influenza pandemic. The historical planning emphasis on avian influenza, or 'bird flu,' unintentionally created a large amount of uncertainty about how to respond to the threat from a milder, less severe, strain of influenza. I suggest that the specter of a future deadly global pandemic of avian influenza spurred a fascination or myopia in global health policy reminiscent of the mythical danger of listening to the Greek Sirens' song. Throughout this dissertation, I attempt to make sense out of the various and still-emerging accounts of the "swine flu" or 2009 H1N1 outbreak. Thus, I define 'pathography' here as the combined historical, biological, social, political, economic and cultural narratives of the 2009 pandemic. The first section explores the historical and biological origins of influenza. Chapter one examines influenza research and early attempts to sequence the H1N1 virus. I use the genetic structure of the virus to suggest that public health agencies are related through a 'viral kinship.' Chapter two details the material processes involved in the sequencing and discovery of influenza viruses. In it, I argue that what virology laboratories construct through these material processes of DNA sequencing is not – reductio ad absurdum – the virus itself, or even simply 'knowledge' about a virus, but rather a complex network of scientists, laboratories, farms, public health institutions and other 'actors' involved in the circulation of influenza samples and genetic information about influenza viruses. Chapter Three explores Hong Kong's history as an international 'lab' for disease research, its local identity crisis as a former colony and current position as a Chinese city, and its unique role within global scientific and public health networks. The H1N1 virus is not simply a symbol of the complex global forces that shaped its emergence and its spread, the microscopic 2009 H1N1 virus embodies those macroscopic forces. Using the terms of molecular biology itself, I would like to suggest here that influenza viruses are not born sui generis out of larger economic, political or social processes, but are both created from and used to create the worlds in which they inhabit. The second section of the dissertation deals with this macro-level of analysis, or the political and cultural ramifications of influenza pandemics. Chapter four examines the seemingly new paradigm shift within global public health from the use of a scientific "certainty" to a biological and situational "uncertainty" as one of the foundations of response to infectious disease outbreaks. Chapter five analyzes the production, collection and sharing of epidemiological information during a pandemic. Scientific facts about the virus and the pandemic were

freely circulated and agreed upon, but their cultural and political interpretations needed to be continuously negotiated. I argue that not only are cultural politics alive and well, but that they played a vital role in the global response to the influenza outbreak. Finally, I argue that to understand the pandemic as more than just a biological, social, political or historical event, one must look at all these narratives at once. The influenza virus is not thus merely a symbol of our times or for an increasingly globalized world; instead, I argue that it has partially constructed – and continues to shape – the contours of our world.

Table of Contents

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PREFACE

Pathography: A Short Definition

To begin, this is a story of other people's stories. It is a narrative of other narratives. The biggest challenge in writing a 'pathography' of unfolding events – a term borrowed from literary publishing to describe any biographical narrative of 'negative events' or illness – is to make sense out of the various and still-emerging accounts of those events, in this case the 'swine flu' or H1N1 outbreaks of 2009. How can we write about something as it happens? How can we tell the story of a story as it unfolds? To make matters even more difficult, I was inside the story of H1N1 almost from the beginning of the outbreak; my research began *in media res*, not *ex post facto*. The immediate result of this submersion in the public health landscape during the H1N1 pandemic has been that perspective, so to speak, has consistently been hard to come by. Rather than endeavor to write a strictly linear 'story' of the pandemic, then, I attempt here to recreate and analyze the various stories – historical, scientific, global, political, popular, and personal – about 'the flu.'

In contradistinction to the strictly literary use of the term, I define pathography here as the combined historical, biological, social, political, economic and cultural narratives of the 2009 pandemic. I self-consciously borrowed the idea of beginning this dissertation with a prologue, rather than with a more traditional introductory chapter with its resultant literature review and methodology sections, from anthropologist Sharon Traweek's seminal ethnography of high-energy physics, *Beamtimes and Lifetimes*. It is my way of enacting the concept of pathography as my analytical guide from the very start; to begin here with a more traditional literature review or introductory chapter which detailed the arguments or structure of this dissertation would be to reify an 'objective' or quasi-scientific conceptualization of the pandemic.

The way this dissertation is written is – in point of fact – part of its overall argument. Just as Sharon Traweek followed particle detectors as her "key informants" – scientific objects that at once combined science with nature, knowledge with passion (17) – I focus here on the influenza viruses as my own key informants. Recent works in science and technology studies using scientific objects as a potent way to trace out networks and associations between human and non-human actors (Hayden 2003, Mitchell 2002) have argued that such attempts to 'track' objects are about far more than the connections between humans and non-humans or the question of agency. Depicting an influenza virus as one of my "informants" here is tied up with far larger political and epistemological questions. The H1N1 and H5N1 viruses are, so to speak, my dual guides through the 'illness narrative' of global public health. I tracked them as a forensic journalist would chart a money trail. I encountered flu viruses in the field and I examined them under microscopes. As with the virologists and epidemiologists at the core of my pathography, I found that both my own knowledge production and my own passions became inextricably entangled in a shifting, evolving mess of viral RNA. Like Victor Hugo in *The Hunchback of Notre Dame*, however, I self-consciously chose to make characters out of the city of Hong Kong, the cathedral of high science that is the U.S. Centers for Disease Control, global public health, and the 2009 H1N1 virus itself. To tell a true pathography, one must at least try to let the key informants 'speak' for themselves.

Make no mistake; viruses are at the heart of the multi-layered, multi-scaled story that is about to unfold.

The first section of this dissertation explores the historical and biological origins of influenza. Chapter one examines influenza research and early attempts to sequence the H1N1 virus. I use the genetic structure of the virus to suggest that public health agencies are related through a 'viral kinship.' Chapter two explores Hong Kong's history as an international 'lab' for disease research, its local identity crisis as a former colony and current position as a Chinese city, and its unique role within global scientific and public health networks. The H1N1 virus is not simply a symbol of the complex global forces that shaped its emergence and its spread, the microscopic 2009 H1N1 virus embodies those macroscopic forces. Using the terms of molecular biology itself, I would like to suggest here that influenza viruses are not born sui generis out of larger economic, political or social processes, but are both created from and used to create the worlds which they inhabit.

Breaking away from biological narratives, the second section of this dissertation deals with a more 'macro-level' of analysis, or the political and cultural ramifications of influenza pandemics. Chapter three examines the seemingly new paradigm shift within global public health from the use of a scientific 'certainty' to a biological and situational 'uncertainty' as one of the foundations of response to infectious disease outbreaks. Chapter four analyzes the production, collection and sharing of epidemiological information during a pandemic. Scientific facts about the virus and the pandemic were freely circulated and agreed upon, but their cultural and political interpretations needed to be continuously negotiated. I argue that not only are cultural politics alive and well, but that they played a vital role in the global response to the influenza outbreak.

Throughout this dissertation, I use pathography as a method to help me analyze the various scientific, political and cultural narratives about and the official public health responses to the recent 2009 H1N1 influenza pandemic. The historical planning emphasis on avian influenza, or 'bird flu,' unintentionally created a large amount of uncertainty about how to respond to the threat from a milder, less severe, strain of influenza. I suggest that the specter of a future deadly global pandemic of avian influenza spurred a fascination or myopia in global health policy reminiscent of the mythical danger of listening to the Greek Sirens' song. In the conclusion, I suggest that in order to understand any pandemic or infectious disease outbreak as more than a biological, social, political or historical event, one must attempt to look at all these narratives at once. The influenza virus is not merely a symbol of our times or for an increasingly globalized world; instead, I argue that it has partially constructed – and continues to shape – the contours of our world. Ultimately, then, this dissertation is written as a pathography of global public health's experience with the 'having the flu.'

On Superorganisms

In writing a traditional, literary pathography, the author usually magnifies negative events or effects in her life. Disease or misfortune itself becomes a central character, an antagonistic figure at the foreground of the story. The author is most often

shown in an overtly heroic role, battling against cancer or addiction or abuse, withstanding an onslaught of terrible happenings in his life.

In my attempt to craft a narrative of influenza's effects on public health, on the world writ large, on the conception of health and illness in the 21st century, and on our personal experiences of life, I have chosen to make the influenza virus itself one of my main protagonists – a character that is not easily, nor necessarily should be, viewed as an enemy. Scientists have recently discovered that 'good' and 'bad' are not easily distinguished at the microscopic level, even with the aid of the best science available to mankind. Viruses are everywhere, more numerous and more unique on a genetic level than anyone had ever previously imagined. Remnants of viruses exist in the uncanniest and most unwelcoming of places – in frozen tundra, buried deep in the sea, and in our own human genetic makeup. Some scientists think that 'junk DNA' like viral remnants might actually be the sole foundation for our own human immune system. In other words, we are currently using old viruses to fight off new viruses. In a sense, then, humans are a collection of walking viruses with hats, shoes and cell phones. We exist now as part of the larger virosphere, one in which every location on our planet shows vestiges of viruses, and viruses are perhaps the oldest 'living' things on the planet. A virus is almost certainly one of our collective ancient ancestors.

Viruses are – let's face it – misunderstood. We instinctively recoil just at the thought of them, as though thinking of viral strains too long might make us more vulnerable to them. By spraying our countertops, squirting antimicrobial solution on our hands, washing everything with bleach, and taking anti-virals we try to eradicate them and wring our collective hands when – despite our best efforts – they advance. But viruses aren't really good or bad things in and of themselves; viruses are strands of ribonucleic acid, or RNA. Viruses don't have motives, or thoughts, or diabolical plans to wreak havoc in our cities. Their function and purpose (if we can even say that they have one) is to replicate, to evolve, to survive. Their overall goal, just like every other living thing on this planet, is simply to stay alive. In other words, they exist because they exist. And that, I think, is what scares us the most. But if we managed to get past all the fear, panic and disgust that viruses generate in us, what might we be able to learn about ourselves from them, about what it means to be human?

If I anthropomorphize viruses, I also humanize other non-biological things, too, like the U.S. Centers for Disease Control (CDC) or the city of Hong Kong, in order to make sense out of the events of 2009 and 2010. And why not? Institutions and cities have their roles to play in this tale of pandemic flu. In this book, I expand on Nicholas Christakis's idea of the superorganism. In his TED talk in May of 2010, Christakis explained that:

> *The argument I'd like to make is that networks have value. They are a kind of social capital. New properties emerge because of our embeddedness in social networks, and these properties inhere, in the structure of the networks, not just in the individuals within them.*
>
> *Our experience of the world depends on the actual structure of the networks in which we're residing and on all the kinds of things that ripple and flow through the network. Now, the reason, I think, that this is the case is that human beings assemble themselves and form a kind of*

> *superorganism. Now, superorganism is a kind of collection of individuals which show or evince behaviors or phenomena that are not reducible to the study of individuals and must be understood by reference to, and by studying the collective, like, for example, a hive of bees that's finding a new nesting site, or a flock of birds that's evading a predator, or a flock of birds that's able to pool their wisdom and navigate and find a tiny speck of an island in the middle of the Pacific, or a pack of wolves that's able to bring down larger prey. Superorganisms have properties that cannot be understood just by studying the individuals.*

Although I agree with Christakis here, in that one must take seriously the institutional structures and networks to understand any experience of the world or phenomena in it, I want to tack back and forth *between* the individual and the superorganism. I am interested not only in how people come to understand what 'flu' is, but how the CDC, World Health Organization (WHO), or 'global health' as a *superorganism* experiences an influenza pandemic. What happened during the 2009-2010 H1N1 influenza pandemic can only begin to be grasped through an examination of multiple layers of experience.

In order to do this task effectively, in this book I will temporarily suspend any ingrained disbelief I have that an institution or network of actors such as the CDC can be anthropomorphized and talked about as an individual – or superorganism. In the chapter that follows, I will use the biological properties of the virus itself to talk about how institutions, cities, scientists, epidemiologists, duck farmers, nations, and the virus construct what we think of as Influenza, and how biological and non-biological 'things' become related to each other via the virus itself. In essence, I explore how the properties of the virus inhere in the structures, laboratories, and networks it helps to create.

PART ONE: Overture to the 2009 H1N1 Pandemic: The 'Siren Song' of Influenza

> *Since 2005, when we deployed this specific real-time PCR assay to detect H5, we ended up getting more of these un-subtypeable samples sent to us. No one suspected that they had swine virus. Lo and behold, the lab found out that these were a novel virus. No one seems to care about seasonal pandemics.*
>
> – Jack[1], a virologist working at a national health agency

> *At the time, we were asked to look into a SARS case on a Chinese train. It was a media report about a young Chinese newlywed dying quite rapidly from a respiratory infection. We spent quite a bit of time dealing with this, and were perhaps not as perceptive to the H1N1 outbreak.*
>
> – Rene, epidemiologist at a national health agency

> *I think there are two camps: "we're all going to die," and "there's nothing to worry about and we don't want to overreact," or "I've got my bird flu plan." But that didn't help with this outbreak. We were too H5 focused, so that when we got this shift, we were uncertain about where to go.*
>
> – Martha, epidemiologist from X County Department of Public Health, United States

In Greek mythology, the Sirens were depicted as god-like creatures that lived on an island in the sea. It was said that their singing was so delicious to the ears of men that any who sailed past their island were certain to be lured to their deaths. The Sirens were half-human and half-bird – portrayed in early Greek art with the head of a female and the torso and legs of a bird.[2] At their clawed feet lay heaps of skeletal remains, human remnants of those who had heard the Sirens' call and never returned. In classicist Edith Hamilton's seminal work, *Mythology*, the Sirens appear only twice: once when Orpheus saves Jason and the Argonauts from sure destruction by drowning out the voices of the Sirens by playing his lyre, allowing the Argonauts to safely sail past the island; and again in the famed story of Ulysses, when the cunning goddess Circe helps Ulysses to escape the Sirens' call by enjoining him to pack his crew's ears with wax. In Hamilton's account, however, Ulysses desires to hear the Sirens' song and stubbornly refuses to stop up his own ears, instructing his men to instead tie him firmly to the mast of their ship and

[1] All names used here and throughout the remainder of this text are pseudonyms. Because of the sensitive and sometimes political nature of the information shared with me, I have made every effort to disguise the unique identity of every informant. Because the world of public health is relatively small and relies heavily on personal connections and trust, my efforts to mask an individual's identity has often included – at times – the need to mask certain information concerning an individual's division or unit of employment, or in certain cases, even their agency or institutional affiliation. Whenever possible, however, I have used either the actual place of employment or a close approximation. Most of the interviews I conducted regarding the H1N1 outbreak response were either "off the record" or part of discussions that happened during professional conferences, meetings or workshops.

[2] In later years, the Sirens would be blended into another form – the mermaid. Although the Sirens might have lost their wings and bird body, they maintained their storied ability to lure sailors to their doom. Greek art shows the slow transformation, as the Sirens gained a human and sexualized torso along with their tailfin and scales.

to ignore all his pleas to be unfastened. As they sail past, Ulysses hears the Sirens singing and Hamilton tells us that it was the words of their song – and not the melody itself – that was the most enticing and maddening. The Sirens' song promised knowledge far beyond man's ken, "ripe wisdom and a quickening of the spirit" (Hamilton, 214). Hamilton asserts that it is this promise of god-like knowledge that drove men to their deaths, not the sheer beauty of the Sirens' song itself. With access to such information, mankind would be able not only to see into the future but to know all things. No wonder, then, that two thousand years after Ulysses first heard their invitation, the Sirens' song remains so compelling.

Hamilton's retelling of the classical myth of Ulysses and the Sirens' song is both a fruitful metaphor for and an analytical tool to unpack the beginnings – or origins – of our own very modern, 21st century concern with influenza pandemics. Not only is the myth of the Sirens' song productive for examining the various 'origin stories' of influenza as a global threat, it also proves a useful device for exploring how pandemic influenza or 'pan-flu' became one of the cornerstones for the creation and strengthening of global health networks, infectious disease response, and national and international pandemic planning. The specter of a global pandemic of influenza – more specifically, what is more generically referred to in both public health circles and in the popular media as avian influenza or 'bird flu' or H5N1 – spurred a fascination or myopia in policy reminiscent of the danger of listening to the Sirens' song. Planning that had focused almost exclusively upon H5N1 ultimately left public health institutions, both at the national and international levels, largely unprepared for a pandemic of a milder strain of influenza – in this case, the 'swine flu' or novel H1N1 influenza outbreak that occurred in the early spring of 2009.[3] The historical planning emphasis on bird flu, as one public health official suggested during a closed conference on H1N1 held in the summer of 2009, had unintentionally created a large amount of uncertainty about how to respond to any other type of milder infectious disease threat. The public health community, it seemed, had become too engrossed by the 'origin story' of a bird flu coming out of Asia to pay much attention to any of the early warning signs of a late-season outbreak of an influenza-like illness in Mexico.

Playfully then, but also all-too seriously, I argue that it was the half-bird, half-human Siren virus of H5N1 that eventually enticed the ship of global public health off its 'all-hazard' course, making influenza its top infectious disease priority. As one top U.S. virologist admitted at a 2009 workshop on the international response to H1N1: "We were planning on a severe pandemic, from a bird, not from a swine and not in North America. All the plans had a flu coming out of Southeast Asia." In the following chapters analyzing the different 'origins' of influenza, I will attempt to show how a general scientific and public fixation, almost religious in tone, on an apocalyptic influenza virus emerging from Southeast Asia developed throughout the past century.

Lest I be charged here with being remiss in reflexively discussing my own enduring interest in the topic, I fully admit that the threat of an influenza pandemic has continued to beguile me over the years. As a long-time amateur scholar of viruses living abroad in Hong Kong, I quickly became mesmerized by the idea of a deadly outbreak of 'bird flu'; so much so that I eventually wrote a novel – a badly-plotted medical thriller –

[3] The similarities and differences – both biologically and historically speaking – between the H5N1 and H1N1 viral strains will be explained and explored in more detail and depth in the following chapter.

centered around an emergent strain of avian influenza circling the globe, generally wreaking havoc, and causing massive social and economic disruptions everywhere an outbreak occurred. As a fiction writer, I could afford to buy into the hype surrounding the H5N1 virus. But years later and as a scholar, I wanted to delve much deeper into the scientific and social rationales that undergird the various international efforts to plan for, and ultimately to prevent, a global pandemic of influenza. I wanted to explore how this object – the influenza virus – affected our conception of public health, how influenza had developed into an international subject of great importance, and what 'work' the threat of a future pandemic did in terms of shaping the economic, political, and cultural contours of our world. This was my goal for writing a pathography – or a multi-layered narrative of an illness – of influenza and global public health.

Throughout this section, I explore the following set of questions about our collective concern or obsession with the influenza virus: First, how did we get here? Why did an imagined threat of a deadly influenza pandemic prove to be so overwhelmingly enticing to those public health officials and policy makers who heeded its call? Historically, why has pandemic influenza been such a hot topic, with such a stranglehold on both popular and governmental imaginations throughout the past century? How did a specific subtype and strain of influenza virus – particularly H5N1 – develop into one of the single-most compelling symbols of a global pandemic? How did the 2009 H1N1 virus reshape how scientists and the public conceptualized pandemics and public health? What might an examination of the events of 2009 tell us about global public health, influenza, cultural politics, and the future of pandemic planning?

In many ways, the lineage of both the H1N1 virus (or the subtype of influenza virus more commonly referred to as 'swine flu') and the H5N1 virus (the subtype typically associated with 'bird flu') can be charted back to public health's past experiences with infectious diseases such as plague, cholera, HIV, and SARS. As novel or 'emergent' viruses, both H1N1 and H5N1's social, political and economic genealogies (as shown in Chapter One through an analysis of H1N1's evolutionary biology or *viral kinship*, and in Chapter Two in relationship to historical origin stories in Hong Kong) are arguably much more recent. Yet political and economic narratives about H1N1 and H5N1, too, have their basis in the history of virology, epidemiology, and global public health. In Chapter One, I argue that the origins of the primarily Western concern over reemerging and novel strains of influenza, like H1N1 and H5N1, can be directly traced back to tensions over China's rise to power and increasing global influence. These more 'social' or 'cultural' issues can be seen within the early scientific attempts to genetically sequence the H1N1 virus, in attempts to answer the question of "where this virus came from," and post-hoc efforts to prove that the H1N1 virus really did originate in Southeast Asia. The resulting biological kinship chart for the 2009 A (H1N1) virus delineates not just a series of random proteins and remixing of viral strains, but highlights all the global economic and political networks that gave rise to the influenza pandemic. The biological origins of the H1N1 virus, then, cannot be so easily separated out from its more 'social,' historical, or political origins.

Borrowing a page from Foucault, I argue that the various origin stories of modern-day influenza pandemics[4] are ultimately "about space, about language, and about

[4] Although the pandemic flu of 1918 has heavily factored into the popular origin stories of H1N1 and the need for pandemic preparedness and response strategies, I will not really touch upon it here. Most of the

death" (1994, ix). This beginning section on origins, then, is also about the creation and sharing of knowledge about the class of influenza viruses collectively known as Influenza A. For me, these origin stories are three-fold: biological, historical, and social. Throughout what follows, the Greek metaphor of the Siren song will echo in my analysis of these different, but overlapping, levels – from the microscopic to the macroscopic. The generally accepted stories about the origins of influenza A viral strains from a scientific perspective mirror the recent cultural, institutional and political narratives concerning pandemic flu and the global public health response, told from a more macroscopic perspective. And yet told in juxtaposition or in close relationship to each other, the narratives of H1N1 and H5N1 tell a modern mythical tale of a deadly scourge that never was but will soon be. The origin stories about pandemic flu that I examine in this section will then form the basis of the more political ramifications of the global 2009-2010 H1N1 pandemic response (as discussed in Part Two). These origins stories fittingly construct the theoretical foundation for everything that will follow them.

My own narrative of the 2009 H1N1 pandemic – or the pathography of influenza and global public health – begins at the beginning, starting with the biology of the H1N1 virus itself. The first step in telling or retelling a story about anything – be it about an event, an individual, a place, an object or a time period – is to identify what, exactly, the central character at the heart of the narrative will be, and from there to decide from whence to begin the tale. The structure of the entire narrative, if you will, is determined in part by the chosen protagonist, which is what makes the job of the non-fiction writer of real events so fraught with difficulties. Choices must be made. One must begin *somewhere* and the pathography of the H1N1 influenza virus may as well begin with the most basic building blocks of the virus itself – or with its genetic sequence. What interests me about the molecular biology or the genetic history of the virus is that, in the most literal sense of the terms, beginning with the virus's unique RNA segments will allow me to both define the object of my study and to delineate its terms. It will also help me to begin to patch together the social, scientific and cultural forces that have turned the entire class of influenza A viruses into a thing in the world – one that garners a massive amount of not only media attention and public concern, but governmental funding and scientific energy. It was the promise of knowledge about the nature of influenza and the prevention of all future pandemics that H5N1, or avian influenza, has held out to public health officials since 1997 that has made it so attractive an object for scientific study; it is this imagined *future guarantee* of useful or 'actionable' public health information that has made H5N1 and other novel Influenza A viruses the central focal point of international research, surveillance, networking and planning efforts over the past decade. It was also this type of intense scientific spotlight upon one specific infectious disease that eventually led to an overall public health *unpreparedness* for the outbreak of H1N1 in the early spring of 2009.

As part of my examination of the social, historical and political origins of pandemic influenza and H5N1 in particular, in Chapter Two I argue that the Asian metropolis of Hong Kong can – at least in part – be reconceptualized here as a kind of modern-day substitute for the mythical island of the Sirens, as a modern international

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public health practitioners that I have worked closely with or interviewed over the past year point to H5N1 as the raison d'être for the need for pandemic preparedness. Fear about 'bird flu' has driven almost every pandemic flu plan that has been created, which I will discuss in more detail below.

petri dish for infectious disease research. As a modern, partly-mythologized ‘hotbed’ of infectious disease, Hong Kong has played a crucial role as the birthplace of not only most past and future pandemics, but as what I want to call an original ‘living laboratory’ for scientists studying both infectious disease and mainland China. As the original setting for the discovery of the plague bacillus over 100 years ago by Alexandre Yersin, Hong Kong has continued its historical legacy as a good place to study disease, especially so-called tropical or emergent diseases. As I will try to show, one cannot trace out the pathography of influenza without an excursion through ‘Asia’s International Petri Dish,’ deadly home of viral Sirens.

CHAPTER ONE

Seeing the Past or Telling the Future? On Origins, Genetic Phylogeny, and Viral Kinship

> *It is so difficult to find the beginning. Or, better: it is difficult to begin at the beginning. And not try to go further back.*
>
> -- Ludwig Wittgenstein, *On Certainty*

Introduction: On Origins and Viral Kinship

By the time I started to write about the origins of influenza, several months had passed since the initial outbreak of H1N1 in Mexico during the early spring of 2009. By late summer of 2010, the WHO officially declared that the global pandemic was over, and yet I was discovering that I still had far less perspective on events than any historian or thoughtful scholar attempting to write a 'factually accurate' account might desire or require of themselves. I chose – perhaps artificially – to begin my examination of the 2009 H1N1 pandemic through an analysis of the biology of the virus itself. Biology and genetics might seem a peculiar place to begin any investigation of the historical origins or 'social kinship' of a particular virus, but it becomes far more appropriate to the task at hand once one considers how the spread of a particular strain of influenza virus becomes labeled as a 'pandemic' in the first place. In deciding to begin with biology, then, I am attempting to define the object of my study.

In retrospect, beginning within the realm of the scientific laboratory also seemed like a good choice primarily because the biology of the virus – or explaining H1N1 through its virology and genetic makeup – would be easier than examining the social, political, and economic aspects of the virus. It would delineate what I meant when I referred to 'H1N1'; in effect, it would ground my study of influenza by defining my protagonist, or the object at the very center of the 2009 pandemic.

Once I began the painstaking process of reviewing scientific articles, re-interviewing virologists and epidemiologists, and going through my copious field notes, however, I realized almost immediately that I had been horrifically naïve in my initial assumptions about the virus. The biological beginnings of the 2009 A(H1N1) influenza virus are anything but 'simple.' In fact, the biological – or scientific – origin story has become one of the trickiest narratives about the H1N1 virus, or the resulting pandemic, to recount or analyze.

Attempting to retell the tale of the 2009 A(H1N1) pandemic, whether beginning from the history of influenza pandemics, or the threat of avian influenza, or global funding for international influenza surveillance networks, or the social and political aspects of decision-making during a pandemic, all explanatory roads eventually lead back to biology – or the genetic sequence of the virus – and converges upon the moment that the virus first became 'known' or understandable. A virus's unique genetic sequence can be conceptualized as a kind of scientific Rosetta Stone, essential not only for an accurate reading of a virus's present (or sudden presence on the global stage), but for working out its evolutionary past and predicting its epidemic future. From a scientific standpoint, the

biology or genetic sequence of an influenza virus is integral to answering the central question: *Where did this virus come from?* From an epidemiology or public health standpoint, the genetic sequence provides crucial information about a virus's virulence, its severity, its transmissibility. It aids in the development of an effective vaccine. But the genetic sequence is also, from my own anthropological perspective, a key to understanding how the social comes to insert itself into the biological, or how human culture invades viral cultures. The story of an influenza pandemic or a particular virus cannot simply be told from a single perspective of 'science,' or 'history,' or 'epidemiology,' or 'culture.' A virus's genetic lineage is much more complicated than that; it refuses any simple explanation of its being in the world, just as it defies any traditional methods of taxonomy.

Throughout this chapter, I utilize the sequencing of influenza viruses and their resulting genetic phylogeny trees – or evolutionary trees – as an anthropological lens. The 2009 A(H1N1) virus itself – or its genetic evolutionary history and makeup – can help us start to piece together how a pig farm in Canada or the Ukraine might be connected to a rural outbreak in Mexico, travelers quarantined inside a Hong Kong hotel, or a lab worker collecting and analyzing virus samples – objects, locations, events and practices which at first glance don't seem intimately inter-related at all. In the end, I suggest that the evolutionary tree of a virus is often 'read' by virologists and epidemiologists as a type of kinship chart; by 'reading' a phylogenic tree, one can arguably be said to 'know' the origin story of a particular virus. But what stands out – especially in the process of discovering, analyzing, and naming a virus – is not the biological heritage of a particular viral strain, but its kinship to places, people and other objects – and particularly its biological relationship to other influenza strains, such the H5N1 or the 1918 pandemic strain of H1N1.

In this chapter, I intentionally borrow a biological metaphor from Bertrand Russell, who suggested in his book *Power* that organizations might be better viewed as "organisms with a life of their own" and as "affecting the lives of the individuals who compose them" (127). In this way, then, I will consider viruses, scientists, laboratories, and the institutions which house them "as far as possible without regard to their purposes" (Russell, 127) from either a political or economic perspective. This will allow me to play with the ways in which viruses are not only 'real' organism with 'real' agency, but also as pervasive in the crafting of a new type of relationality between different locations and 'organisms' in both time and space. Nodes in the global public health network are related through the virus, so it should not be all that surprising if those same institutional relationships shared certain characteristics with the virus. This chapter, then, ultimately examines not just how human cultures might invade viral cultures, but how viral cultures invade human cultures.

Making Sense of Gene Sequences: Taxonomy, Biological Relatedness, and the Production of Genetic Phylogeny

Before delving into a more specific analysis of the 2009 H1N1 virus's genetic makeup, one must first attempt to answer a series of interrelated questions: What is a 'novel' influenza virus in the first place, where the term 'novel' is used to indicate not

only the biological or genetic difference of a particular viral strain but also its potential for causing a deadly pandemic? How does a particular strain of influenza like H1N1 first become the object of international scientific interest? How does the public health community come to the conclusion that a viral strain is both 'novel' and dangerous enough to warrant attention or formulate a response? In other words, *what are the genetic differences that make a difference?* Understanding how scientists make sense of a virus's RNA sequences or gene segments (produced through a material process similar to the one described in the preceding section) through the construction of genetic phylogeny trees is a key to answering some of the complex questions posed above. During the course of my research, it seemed to me as if the answer to almost every question regarding the H1N1 influenza pandemic spiraled out from a strand of its viral RNA. The tendrils of RNA stretched themselves out like a webby net, catching all of us up in the collective thrill of deciphering the pandemic future by reading about the viral past. I was a guilty as the next scientist of wanting to know the answers, and hoping that they were to be found in a random series of amino acids.

When virologists talk about the origins of a new or reemergent strain of virus, they often directly refer to the virus's genealogy. In Professor Lau's lab, a genealogical tree of H5N1, or avian influenza, masked the entire backside of his office door. Particular segments had been highlighted in yellow and handwritten notes covered the broad margins. Printouts showing other viral linkages were carefully taped together and completely covered the otherwise empty wall spaces next to work desks throughout the lab. Examples of these 'phylogeny trees' were everywhere – the visible product of the material processes of virus discovery and genetic sequencing.

Technically, the scientific term used to refer to a virus's particular evolutionary history is its *genetic phylogeny*, but many of the terms and phrases utilized by scientists mapping out the genealogy of a virus mirror the more familiar social expressions used to describe familial relationships between persons or groups of persons. A virus is frequently described as a member of or related to a 'family' of viruses, as 'descendent' from other known viruses, or as simply a 'descendant' of another virus. A virus may have close or distant 'relatives,' and different viruses may be said to share a 'common ancestor.' In leading scientific journals such as *Science* and *Nature*, the 2009 H1N1 virus itself was often personified and given human-like agency and traits. One early account of the virus's biological origins even went so far as to suggest that H1N1 was part of a particularly "promiscuous family" (Cohen 2009b). After a cursory reading of the available scientific literature, the close connection between phylogeny, scientific nomenclature, and kinship between viruses becomes unmistakable. And just as with human genealogy and any individual's efforts to discover her personal family history – which inexorably leads to the co-discovery of her economic, social, and political origins, a virus's complex kinship chart highlights not just its biological or molecular connections or history, but the larger social and cultural networks at play in their emergence and spread. What I am interested in here, however, is not just how the production of phylogeny trees might reflect the relationships between disparate objects, places, and people, but how the trees themselves – in an attempt to accurately reflect the virus's biological makeup and history – produce a social relationality through the trope of biological relatedness.

Viral taxonomy, or classification of viruses, has always been a contentious issue amongst scientific researchers (Matthews 1985), in part due to a virus's innate ability to exchange entire genetic segments with other viruses (known as genetic reassortment) and its resultant quick pace of evolutionary change. The class of viruses known as Influenza A have a total of eight different gene segments, which frequently 'reassort' to produce new 'subtypes' of Influenza A viruses (such as H1N1 or H5N1). Thus, the procedure for scientifically naming Influenza A viruses is anything but simple. According to FluGenome, a website dedicated to the development of better web tools to aid researchers in studying the evolutionary phylogeny of Influenza A viruses, the standard nomenclature *should be* as follows:

> Two nomenclature conventions are used routinely in influenza research: 1) the 8 segments in the influenza A genome are numbered from 1 to 8 for PB2, PB1, PA, HA, NP, NA, M, and NS respectively; 2) There are currently 16 subtypes for hemagglutinin (HA), 9 subtypes for neuraminidase (NA), and 2 alleles for nonstructural (NS) proteins. Since influenza A viruses have a complicated genomic structure, we approached genotyping by studying each gene segment separately at first. . . . The use of a nomenclature for influenza A virus genotypes is important, since it will allow researchers to describe influenza A virus genotypes in an equivocal way and avoid the confusion when a genotype is labeled differently by researchers. (2010)

This statement reveals, implicit in its call for a more uniform nomenclature, some of the inherent problems with standardization and prior attempts to produce more inter-lab 'clarity.' In day-to-day practice, the system for naming – or labeling – unique viral segments is anything but uniform. A particular virology lab, such as the one I observed, might craft and utilize their own nomenclature system, making comparison of viral sequences and other information-sharing challenging between collaborators at different institutions. Under the current system, each virology laboratory producing information on individual gene sequences might produce virus 'labels' or nomenclature that 'reads' slightly different, making quick 'translation' among labs working on the same class of viruses that much more difficult. In Professor Lau's lab, influenza viruses were named using the following standardized system: Year/month/species/identification code for host species/identification code for the specific virus sample/specific hemagglutinin and neuraminidase. When I asked Professor Lau if he could easily tell me where – in geographic terms – a gene segment had originated, he responded that they were trying to formulate a way to include the known sample source location in the current nomenclature system.

In practice, however, a commonly circulating influenza virus (in contradistinction to a virus that is being researched on a continual basis or under 'normal surveillance' in a virology lab) is often given a more generic name that reflects its closest-known place of origin, its primary animal host, or its specific subtype. Thus, the 2009 A (H1N1) virus in particular was often referred to both in the press and by professionals exchangeably as

"Mexican flu," "swine flu," and "H1N1."[5] Controversies over these early 'non-scientific' names given to the 2009 A(H1N1) influenza virus were rife and well-reported in the news media (Bradsher 2009, Grady 2009, Weeks 2009). Government officials in places like Mexico or China quickly balked at the suggestion that the flu had originated inside their national borders (McNeil 2009, China Daily 2009, China Daily 2009a); a reaction partially explained by economic fears of halted tourism and trade, and partly through the stigma of being labeled – reflected in the nomenclature itself – as the 'source' of a pandemic strain of flu. The pork industry lobbied for the use of H1N1 due to its concern that the name 'swine flu' would negatively affect the sale of pork (a fear not completely unfounded considering past effects of FMD or 'Mad Cow' disease on international beef sales). Nomenclature, in many ways, would only became a non-issue after the virus's RNA had been carefully 'read' and its origins were better understood.

The various people I had conversations with during the early weeks and months of the pandemic – from California's regional public health departments, working inside national public health agencies, shopping at local superJamesets, or sitting down with me at coffee shops – all wanted to know more about this flu, about where the virus had originated, where it would travel, and how it would act when it got there. What is more, laypersons and professionals alike all-but agreed that a definitive scientific answer to the puzzle of the virus's origins – or genetic phylogeny – might provide them with other vital information or insights about where the virus – and the pandemic – was headed, what shape it would take, and what public health responses would be needed in order to halt its spread.[6] In other words, people seemed to want the virus's RNA to 'speak' to them, to relate its history, and to give up its secrets. Throughout 2009, I often heard discussions about or perused news stories and scientific articles related to the virus's biological heritage, or its kinship to other viruses, both in terms of the distant past[7] as well as the present tense.

As soon as sputum and blood samples from the first index patients in California and Mexico became available, scientists began to isolate and then sequence the H1N1 strain of influenza.[8] In the U.S., the first samples were sent to the CDC from the Naval

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[5] Most of the scientists and epidemiologists I worked with or interviewed during the pandemic still used "swine flu" as shorthand for the virus in informal conversations, well after the official WHO "naming" of the virus as *2009 A (H1N1) Influenza* due to better information about its genetic sequence, push back from Mexico, and complaints from the pork industry. In official communiqués, however, public health professionals were diligent about the use of the scientific nomenclature, at least in part to avoid running into any more "cultural issues" related to the use of "swine flu."

[6] Despite the fact that 'definitive' answers to the question of a particular flu strain's origins – either in biological or geographical terms – are not possible to obtain, the search for them persist. I would like to point out here that the lay and expert desire to discover the 'origins' of influenza viruses are socially constructed. The search for origins, however 'fruitless' it may sometimes appear on the surface, provides a very real foundation for productive scientific research in evolutionary virology.

[7] Almost immediately, the 2009 H1N1 virus was compared to the 1918 H1N1 virus. Scientists were on the lookout for any genetic Jamesers or similarities to the 1918 strain that might indicate that the burgeoning pandemic would be deadlier than a "normal" flu strain. I will talk about this comparison in more detail in the section to follow.

[8] Timely access to samples of novel or reemergent viruses are critical, and the sharing of virus samples – especially at the international level – can sometimes become a contentious topic. See MacPhail 2009 for an analysis of Indonesia and China's reticence to share samples of avian influenza viruses as one pertinent example. In the case of the 2009 H1N1 outbreak, the first available samples of the virus out of Mexico bypassed the CDC labs in Atlanta, and were shipped instead to Canada. This incident caused a few ruffled

Medical Center in San Diego on April 13 (Science 2009: 700). On April 15, the U.S. CDC used polymerase chain reaction (PCR) on the samples and confirmed that the viral strain was different than anything circulating at that time in the U.S. during the normal flu season (personal notes from the ENDS workshop at UC-Berkeley, July 2009). Scientists working on samples in laboratories in Canada, the U.K., and the U.S. made genetic sequences available on public databases. Two weeks later, on April 30, initial genetic analyses of the circulating strain were available on a "wiki-style Web site called 'Human/Swine A/H1N1 Influenza Origins and Evolution' created by two evolutionary biologists in the United Kingdom" (Cohen 2009: 870). In the history of public health flu surveillance and response, the alacrity of the sequencing and evolutionary analysis of the 2009 A (H1N1) virus was unprecedented.

Epidemiologists and scientists working within public health were stunned by the sheer speed of the sequencing, and continuously expressed admiration for the collaborative international efforts that had produced such useful information, under duress and demanding time constraints to boot. A prominent French epidemiologist recalled his own reaction a few months later, stating that: "The genetic sequence was published very, very quickly. I remember seeing it in the New England Journal of Medicine and thinking to myself, 'Wow. This is terrific, to have this kind of information so quickly.' And it seemed like it was done properly. It was good science." While at the a national health agency in the fall of 2009, I continuously heard people working on the H1N1 response reJames on how quickly information had become available in the early days of the outbreak, how easily information had been shared between global partners, and about how smoothly the scientific community had churned out not only the complete genetic sequence of the virus, but comparative data regarding its evolutionary origins. The partial 'origin story' being constructed through the available circulating data on the virus's genetic structure is, then, an artifact of these very technological collaborations.

People expressed reactions to these events as if a small miracle had occurred. The professionals I interviewed both in the United States and in Hong Kong articulated something akin to wonder and delight, and often pointed to the achievement as the *fait accompli* of a new, better, more prepared system of global public health. Articles and interviews in the two leading scientific journals *Science* and *Nature* reflected this sentiment, with prominent virologists and epidemiologists declaring their "amazement" at the sequence sharing capacity (Cohen 2009a: 701), or at how quickly "people mobilized" (Cohen 2009: 870). In many ways, the sequencing of the novel H1N1 virus was seen as the first victory in the battle against H1N1 and a major blow in the larger war against 'the flu.' In point of fact, the complete phylogeny of the virus was available far before the outbreak had even officially been declared a pandemic by the WHO.

Scientists had ascertained from the available genetic sequences that the circulating H1N1 pandemic virus was something called a 'triple reassortant.' In the lingua franca of virology, this – in essence – means that the virus was a rare combination of gene segments from viruses from three different host sources: avian, human and swine. The 2009 A (H1N1) influenza virus, from both a scientific and quasi-anthropological standpoint, had three very different family trees, or a rather complicated 'kinship' to other viruses; it was the unique descendant of viruses from North American pigs, North

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feathers inside the CDC, which had expected to be the first to receive samples from their counterpart agency in Mexico.

American birds, Eurasian pigs, and humans (Cohen 2009a). Still, knowing the percentages of which gene segments came from which sources or generic global locations would not definitively answer the ultimate question that epidemiologists found themselves repeating: Where – *exactly* – had this virus come from? The answer to this question was important not only for accurately naming the virus (as explained above, a virus's known origin point is typically included as a part of its scientific nomenclature), but for understanding more about its initial emergence as well as its early spread.

To borrow a turn of phrase from the Bible, the first scientific articles on the 'origins' of H1N1 read like a story about viruses begetting viruses. Biology here (and perhaps more often than we recognize) equates to a beginning. To understand the H1N1 virus, scientists wanted to not only trace out its viral kinship chart, or to find its parents, but to reconstruct the moment of its 'birth.' An evolutionary virologist explained to me that while it remained scientifically impossible to ascertain exactly when, where, and how a novel virus had reassorted into its present form, the production and analysis of its genetic phylogeny could help scientists to *approximate* the origins of a particular viral strain. In essence, understanding the genetic phylogeny for H1N1 was 'good enough' to explain its past, but remained a poor predictor of its ultimate future. Exactly, I mused, like a newborn baby; knowing H1N1's 'parents' would be little help in guessing what the 'child' would become or might do as an 'adult.' But for many epidemiologists and public health officials, this is exactly what the search for origins is about – an ability to intervene, based on a knowledge of its past, in a virus's future.

Phylogenetic trees for viruses look similar in form to human genealogical trees, with the obvious exception being that phylogenetic trees are based on a virus's RNA structure and are thus much bigger and more intricate in terms of both scale and scope.

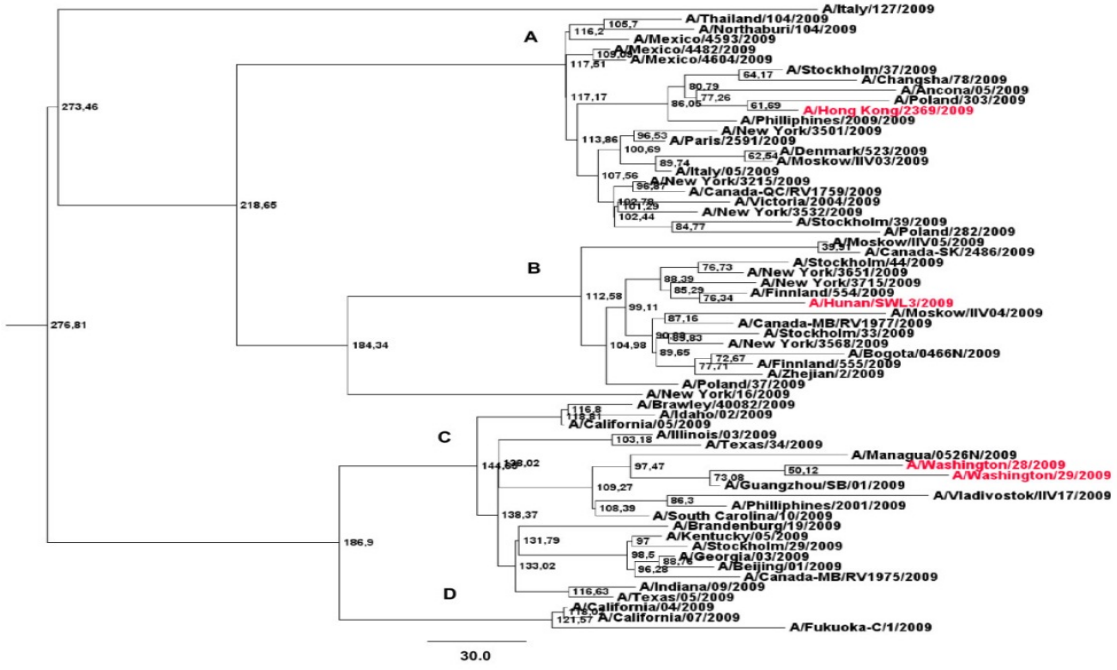

Figure 1: A phylogenetic tree for the NA gene segment of the 2009 A (H1N1) Influenza virus.

Still, the similarity in basic format makes the virus phylogeny tree seem almost intuitively easy to understand, even from a novice's perspective. Genetic phylogeny trees are produced for each of the eight separate segments of an influenza virus (which viewed together constitute the entire genetic evolutionary tree for the virus as a whole). Typically, however, emphasis is placed on the specific gene segments that 'code' for hemagglutinin (HA) and neuraminidase (NA), two proteins that cover the outer surface of an influenza virus and are crucial to its ability to invade a host cell and effectively replicate and infect other cells. Both HA and NA also have a "very high" rate of mutation, due in part to selection pressure stemming from the human immune system (Webster et al, 155). According to eminent evolutionary virologist Robert Webster, these genetic mutations – in addition to gene reassortment – are "one of the most important mechanisms for producing variation in influenza viruses" (153). Information gathered through continual surveillance[9] and genetic sequencing of influenza A viruses is used to track longitudinal changes in an effort to better understand how viruses mutate and reassort into 'novel' – and potentially deadly – strains (which are typically hybrids of strains found in a variety of animal hosts: ducks, wild geese, pigs, humans, and chickens).

Of course, from an anthropological or science studies perspective, the construction of these phylogenetic trees also helps to create a 'novel' strain in the first place. It is the comparison between strains which produces the difference that makes a difference. In addition, phylogenetic *relationships between strains* are analyzed to produce knowledge about the "ecology" of influenza viruses (Webster et al, 1992). The comparison of the phylogenetic trees for individual gene segments, which began in earnest as late as the mid-1990s, led to the scientific discovery of influenza's natural host reservoir (wild ducks) and ultimately undergirded the entire scientific paradigm for evolutionary research on influenza viruses. Information on viral RNA sequences is thus absolutely essential to the work of present-day evolutionary virologists, who track and compare specific changes in nucleotide and amino acid sequences of gene segments to produce information on the known origins, or most recent common ancestor, of seasonal and pandemic flu strains. In the following section, I will examine how these phylogenetic trees are interpreted or 'read' by both scientists and epidemiologists working in public health – two overlapping, yet very distinct, scientific cultures. In the process, I will begin to analyze how the study of biological relatedness between viruses helps to produce relatedness between researchers, places, and institutions.

[9] Influenza viruses are unique in that they have been collected and studied "in different geographical regions" by scientists for well over a century, and thus provide a good "resource" for virologists interested in studying evolutionary change in RNA viruses (Webster 1992). In fact, this rich, century-long data source is the reason that virologist Stephen Morse labeled influenza as a "model" for studying "viral emergence" writ large in his seminal article, "Emerging Viruses: The Evolution of Viruses and Viral Diseases" (1990). Many scholars have since linked our modern obsession with "emergent" viruses (think Nipah, Ebola, and Marburg) to this article, published in The Journal of Infectious Diseases.

Reading the 2009 A (H1N1) 'Family Tree': The Interpretation of Genetic Information within Evolutionary Virology and Global Public Health

In the midst of a growing pandemic, why did those working in public health place so much emphasis on the decoding of a single strand of RNA? What could a gene segment, or a series of random amino acids, tell them about what was happening in Mexico City or San Diego? What do gene sequences mean to the various people involved with 'reading' and interpreting them? More importantly, what might we learn from analyzing gene segments or studying phylogenetic trees – from both a scientific and a social scientific standpoint?

To those of us who are largely unfamiliar with the daily practices or premises of virology, epidemiology or public health, the early and rapid effort to sequence the H1N1 virus might seem a bit peculiar. Most of the epidemiologists that I spoke with all told me the same thing – that certain key pieces of vital information about the virus were missing during the first few days and weeks of the 2009 H1N1 outbreak: its virulence, transmissibility, and origins. Knowing the origins of the virus, or its specific genetic makeup, might allow public health professionals to make more accurate, educated guesses about the spread and severity of the flu. In other words, knowing the origins of the H1N1 virus would lead to better decisions about what types of public health responses would be most effective. In addition, being able to quickly analyze viral DNA would allow scientists to keep tabs on the virus if it mutated or evolved into a more dangerous form.

It was essential, I was repeatedly counseled whenever I asked about the importance of continued global virological surveillance of influenza viruses, to keep track of point mutations (a change in a single base amino acid) and reassortment events (the 'switching out' or 'swapping' of entire gene segments). Evolutionary virologists thought of this as part of a 'basic research' paradigm, one that would eventually help them to understand how influenza viruses evolved in their natural environments. It was vital to study the complex relationship between a virus's ecology and its evolution; the virologists I interviewed believed that genetic phylogeny held a key to unlocking the secrets of how viruses functioned. Generating sequences and compiling computational databases of genetic sequences across time was conceptualized by the evolutionary virologists I spoke with as creating an "oil reserve," or as a process similar to sifting through sediment layers in a "diamond or gold mine"; the more information that was gathered together and compared, the better the chances of understanding viruses. Such information was not, however, of a predictive nature.

As virologist Robert Webster explained in *Science*: "'There is a feeling that once you know the sequence, you know everything about a virus, and you really don't'" (Cohen and Enserink 2009: 573). Virologists familiar with genetic phylogeny repeatedly stressed this point, and were careful to highlight the limitations of knowing the genetic makeup and evolutionary history of a virus. Near the end of my research, I noted a developing divide between what the virologists who produced evolutionary trees thought they *should* be used to do, and what other – less specialized – public health professionals thought they *might* be used to do. Yet, if realizing that the genetic sequence alone could not tell public health professionals everything they wanted to know about the 2009 A (H1N1) virus, that fact had not stopped scientists from racing to sequence the virus and

attempting to use the resulting data to help them piece together its evolutionary history. Epidemiologists in key public health institutions then attempted to utilize this newly available knowledge about the genetic makeup of H1N1 to help them make calculated predictions about the virus's spread and its potential for causing widespread death. Indeed, the U.S. CDC and the WHO eventually retooled their official recommendations for local public health action based – at least in part – upon this information.

The scientific interpretations of the phylogenetic tree of the 2009 A (H1N1) influenza virus offers us a road map to the ways in which scientists analyze and read genetic information, and how they talk about and conceive the intricate relationships between the 2009 virus and other viruses, such as the now infamous 1918 H1N1 virus. After all, the 2009 pandemic strain of influenza A and the 1918 strain were genetically, if distantly, related.[10] A fact that caused not a little concern among those familiar with the deadly pandemic in 1918. The genetic phylogeny of a virus, then, not only reflects but produces a type of kinship – both biological and social – through time and space. As such, the process of genetically mapping and naming a virus such as H1N1 not only traces biological connections and reflects larger social and political structures, but produces and reifies them. After initial discovery, a reemergent or novel virus's RNA sequences are quickly mapped out and compared to other viruses to produce a kind of 'family tree,' one that shows the linkages or 'lineage' of the virus being mapped. When a virus is given a scientific name, its new nomenclature is a direct referent of its 'family' and alleged place of origin. Each virus, through the process of genetic sequencing, is shown to have a certain biologically-based relationship to other viruses. It's not much of a theoretical stretch then, to suggest that one might begin to speak of a kinship between strains of the influenza virus. To begin to suggest here that global health agencies involved in influenza science and surveillance are then themselves somewhat *virally related* is not that much of a conceptual leap. The resultant 'kula ring' of virus samples being collected, analyzed, and shared becomes representative of other – human and macro-level – networks that overlap and interact to produce what we more commonly refer to as global public health. The concept of *viral kinship* reflects the complex working relationships that develop between scientists, farmers, public health institutions, and even the viruses themselves, or what the scientists themselves often referred to as "alliances" between "partners." Viruses, then, are both derivative of and constructive of biological and social relationships.

Evolutionary Virologists on Sequencing, Phylogenetic Trees and 'Gene Flows'

It is important to note at the outset of my analysis here that the first half of my fieldwork was spent working with epidemiologists and analysts inside a Western national health agency. I had cut my public health teeth, so to speak, on a specific formulation of the role that information on the genetic makeup of a virus should play in global disease

[10] One might wonder here if the fact that both the 1918 and the 2009 pandemic influenza strains were H1N1 led those familiar with events at the turn of the last century to react more forcefully and fearfully to the initial outbreak. "Better safe than sorry" was the collective mantra of all the flu experts I came into contact with throughout the second-wave of the pandemic. The rationale for acting quickly to declare a pandemic was certainly not separate from the anxiety over the potential for the 2009 H1N1 strain to 'act' more like it's deadlier 'cousin.'

surveillance or during an outbreak response. My knowledge of the science, in ways that I would not fully realize until my time in Hong Kong, had been colored by my immersion in the daily work of top epidemiologists. It was fortuitous, then, that my first meeting in Hong Kong was with a prominent evolutionary virologist who had been quoted in several high-profile media and science stories on the genetic sequencing of the 2009 A (H1N1) influenza virus. His work on the phylogenetic tree of the virus, as it were, preceded him. After I sat down with Professor Sam Jones to discuss influenza research in Hong Kong, my understanding of the call for more effective global infectious disease surveillance programs, international scientific efforts to track evolutionary changes in influenza viruses, and exactly what RNA could – and couldn't – reveal about a virus would be altered dramatically.

We met for breakfast on an overcast day at a popular brunch spot in Central. Sam's frankness and willingness to talk openly about the 'politics' of working on influenza surprised me. Scientists and epidemiologists in other locations had generally been reluctant to get into discussions about the political side of their work. It was refreshing, then, after so many 'off the record' moments, to have someone quickly acquiesce to my request to tape our conversation.

As an internationally-respected virologist, Sam was 'in the loop.' He had worked inside top labs and under scientists who were already famous infectious disease specialists (including the two men responsible for the initial discovery of the SARS coronavirus). Sam regularly name-dropped throughout our conversation, though in an offhand way, unselfconsciously; he collaborated with renowned scientists on a regular basis, he knew these men well or had trained under them, and though it was still 'early' in his career, he was fast becoming one of them. In other words, although I focus my ethnographic analysis below on one scientist's point of view, Sam's respected position in the 'global' influenza network was unquestionable and his views were echoed by many of the other virologists I spoke with later in my research. His views on the uses of phylogenetic trees were thus not atypical for his position or research focus, but were paradigmatic of the ways in which virologists typically explained their research and its limitations.

For my first question, I asked Sam about the routine sequencing of viral samples in Hong Kong. When I asked if his lab sequenced every virus 'discovered' through randomized sampling and surveillance, Sam laughed and launched into an explanation of the process of sequencing based on his recent experience with swine viruses, or H1N1:

> *No, there's too many. I'll give an example from the pig stuff, because that's what we've been working on a lot recently. We're doing a lot of sequencing of the pigs. So for the pig stuff, we've got about 600 viruses – this is just H1N1 – that have been isolated since 1998. So, we sequence the surface proteins, the HA and NA, of all. And then we do phylogenetic analysis, and then, we sort of decide what to do full genome based on the phylogeny and try to sample equally from different phylogenetic routes on the HA and NA. It's not ideal, but it's <u>really</u> expensive. And then we've chosen about 30%, 20-30% normally, depending on what the total numbers are, and do full genome sequencing.*

In twelve years, then, in one virology lab in the Special Administrative Region, scientists had been able to isolate approximately 600 virus samples of a single subtype of influenza. The genetic information generated from sequencing merely one-third of such collected samples would then be used to compare "nucleotide and amino acid sequences" (Webster 164) of each virus's unique RNA, particularly changes in sequences that are found within the HA and NA gene segments. Phylogenies generated by comparisons between viruses would then be utilized to group viruses into a "sister group relationship" to determine "a common ancestor" (Webster 164). These trees, in turn, are a way to "represent hypothesis about evolutionary relationships among taxa" (Webster 167). What virologists like Sam and Robert Webster hope to ascertain from the information represented by phylogenetic trees is "a more complete picture of virus evolution" (Webster 167), or a greater understanding of the ecology of viruses, even if the genetic sequences and phylogenetic trees can self-admittedly never be used to pinpoint the specific origin or emergence of a particular viral strain (Webster 171).

When I mentioned Robert Webster's quote in the *Science* article on the origins of H1N1, Sam smiled. I asked him how good the predictive quality of the sequencing was. He responded quickly:

> *Oh, it's not. You've got to biologically characterize it. You can sequence something, and say it's got a mutation that confers oseltamivir [Tamiflu] resistance. If you read the papers, what they should say, and hopefully what we always say, is that it is predicted to confer oseltamivir resistance. Because you get a nucleotide, you haven't even sequenced the amino acid, and then we just convert it using the universal code into amino acid and then it's got the resistance Jameser. But unless you test it – that virus – directly against that drug, you cannot say. And on a simple measure, I think that's what he's saying. But a lot of the focus on information-sharing and things like that, it's all been information sharing, there's not been things about viruses and sharing as such. So a lot of the criticism is, oh, you've got to provide the sequences. But what are you going to do with that? I mean, you can't actually do anything with it. You can look into the past, but you can't look at the future. I think the real hope is a need for real-time surveillance. What we're trying to do with it from a disease-control point of view is we're looking at gene flows. If you've got gene flows between different host populations [typically between bird, pig, and human], then past experience tells you that something's going to happen.*

Genetic information, then, is useless without contextual information regarding how the virus will act inside a live host in 'real-time.' RNA, it seems, can only tell us so much. And what it can tell us, according to evolutionary virologists like Robert Webster and Sam Jones, is mostly about the virus's past – not about its present or its future. The predictive qualities of phylogenetic trees are thus chronically lacking. Evolutionary virologists, in their present-day quest to understand how genes 'flow' from one host to another, how viruses move through their natural environments, seek not to foretell the future, but to be better prepared in the present. The resultant informational 'flow'

between labs was integral to the scientific pursuit of knowledge regarding the origins of the circulating and evolving pandemic influenza strain, about its viral past.

The past tense is ever-present in influenza science. As the "model" virus for the scientific study of disease emergence and evolution (see Morse 1990 and Webster 1992 for further explication of how influenza came to be paradigmatic for research on other emerging viruses), influenza has been studied for over a century (Webster 153). In a sense, it is the rich history and long-standing practice of influenza research that connects people, places, and things like viral samples in the present tense; evolutionary virology entails a practice of looking for origins that is only partially captured by the creation and reading of phylogenetic trees. Virus samples are collected; they are shared; they are sequenced collaboratively in a lab[11]; their genetic information is analyzed collaborative on the web. This informational chain intra-connects scientists and interconnects the people, practices, and the objects that they study.

A 'Family' that Researches Together: The 'Father' of Evolutionary Virology of Influenza

At the heart of all this is a 'family' of influenza viruses (Influenza A) and their attendant 'family' of researchers, a family that literally helps to shape – both physically and semantically – the world of influenza science. At the center of this research 'family' is the 'father' of the science and practice of the evolutionary virology of influenza, Robert Webster. In many ways, Webster's personal history reads like the history of influenza science itself. The collection of scientific articles written or co-authored by Robert Webster (Webster's professional webpage at St. Jude's hospital lists this number as over 500 and counting) can in turn be analyzed to produce a 'tree' or web of relatedness among influenza researchers. Most influential virologists working on influenza have either been trained by Webster, worked with him, or rely upon his work as a foundation for their own. Over the past decade, Webster has been inducted into the Royal Society in London (the oldest scientific society in the world) and the National Academy of Sciences, acted as a consultant to the WHO and the National Institute of Allergy and Infectious Disease (NIAID), and is the Director of the U.S. Collaborating Center of the WHO for the ecology of animal influenza viruses (St. Jude 2011). In essence, and at the risk of sounding glib, Dr. Robert Webster is a prominent and highly-respected virologist and 'founding father' of the evolutionary virology of influenza. His opinion matters greatly and his research is foundational to a global network of researchers working on the class of viruses known as Influenza A.

Webster began his work on influenza in 1957, when he 'discovered' that human pandemic influenza, such as the deadly 1918 H1N1 A virus and the 1957 pandemic, had descended from viruses affecting animals and birds. The narrative of the pivotal founding event of his future career as an evolutionary virology is itself myth-like. According to a feature article on Webster published in the Smithsonian Magazine, Webster was walking "along an Australian beach in the 1960s" (Rosenwald 2006) with his research partner, Graeme Laver. As they "strolled," they passed a dead "mutton bird" about every 15 yards (Rosenwald 2006). Knowing that a flu virus had recently been pinpointed as the cause of death of birds in South Africa, Webster turned to his lab partner and asked: "'What if the

[11] For a detailed description of the lab practices and processes that turn soil samples into information on influenza, see the following extended interlude on the "Realness of RNA."

flu killed these birds'" (Rosenwald 2006)? The two men then embarked on a research trip together, eventually swabbing the throats of "hundreds" of birds; 18 of those first samples would test positive for antibodies to the human virus that had caused the 1957 influenza pandemic (Rosenwald 2006). Thus, Webster and his 'partner' gave birth to a research program that has lasted for more than 50 years.

A quick perusal of Webster's extensive list of important publications might be productively mapped to craft a 'phylogenetic chart' of influenza researchers, all showing Webster as their progenitor or 'pater familias.' During my own research in Hong Kong, I began to think of the ways in which viruses as objects of intense scientific research connected a variety of people, places, and institutions after hearing Robert Webster's name mentioned in five separate interviews with virologists. This should have been less strange to me, I suppose, since I knew that Webster had collaborated on research with the men responsible for the discovery of the SARS corona virus, Guan Yi and Malik Peiris (prominent virologists in their own right and both currently professors at the University of Hong Kong). And yet it struck me that one could not have a conversation about evolutionary virology in Hong Kong without Robert Webster or his protégé, Richard Webby's (also at St. Jude's and current Director for the WHO Collaborating Center for Studies on the Ecology of Influenza in Animals and Birds), work in the United States being discussed. Robert Webster connected people – geographically and intellectually – through their common interests or training in research on influenza viruses. The virus samples themselves, I had seen for myself, were connecting people into collaborative alliances. And together, the 'father' of influenza science and the viruses, they had created a billion-dollar global network for surveillance and laboratory research on a single class of Influenza A viruses.

The international research focus on influenza, initially begun by Webster and Laver, had constructed behemoth global networks, such as WHO Global Influenza Surveillance Network (GISN) and its information-sharing tool, FluNet, out of these smaller, more intimate, personal alliances. The respect that Robert Webster commanded was more-or-less easily transferred to the laboratory research practices that he had begun and continued to vocally support. At the heart of all this, however, were the viruses themselves – a family that produced a family that produced a family. As objects of fascination and compelling interest, the influenza viruses both connect and are connected by human practices – both inside and outside of the lab. The work that the sequencing of viruses does is considerable. As one press release from EuroSurveillance stated, the sequencing of viral isolates of the 2009 A(H1N1) influenza virus "is allowing thousands of scientists to participate in the endeavor" (2009).

But once a phylogenetic tree is constructed by this network, or virally related 'family' of scientific researchers working with viral isolates, how is the resultant phylogenetic information then understood – or reinterpreted – *outside* the virology lab? If, as virologists like Robert Webster and Sam Jones have argued, phylogenetic information should not be used to predict the future of a pandemic, then how is information on RNA being utilized by epidemiologists and other public health officials working within national public health agencies? In other words, how does someone outside the research family interpret the same information?

In the section below, I will briefly highlight how such genetic information is used by epidemiologists and public health officials to make 'educated guesses' related to the

future course, severity, and duration of an outbreak. During the earliest stages of the 2009 pandemic, the phylogenetic tree for the H1N1 (A) virus was seen as a crucial piece of information in assessing the risk to the general population and for collectively deciding upon the best possible response actions.

"Guesstimating" the Future of H1N1 – Various Interpretations of Phylogenetic Data

It would be facile to assume that the information generated in the lab about viral RNA is merely a fixation within the epidemiological community. Yet whenever I discussed the matter with virologists, epidemiologists, or public health officials, it often seemed to me that recent advancements in the quality, speed, and cost of sequencing technology had turned the solution to every problem into a random series of amino acids. As I spent more time with virologists and epidemiologists, however, I began to see that what appeared to be an preoccupation with genetic information and phylogenic trees was not just about our modern fascination with DNA and genetic codes. If virologists were interested in knowing about the genetic makeup of viruses to better understand viral ecology and evolution, then epidemiologists and those in public health wanted to see an analysis of the virus's RNA so that they might make better guesses about the future of a developing pandemic. There was an epistemological breakdown between the science and its application. Virologists and epidemiologists had different interpretations of the same phylogenetic information because they had, in effect, different goals (though 'related' to each other, virology and epidemiology are two very different 'families' within global public health). The epidemiologists' 'practical' goals of predicting the virus's future actions were more immediate, since they viewed themselves as front-line players in the effort to halt the spread of the virus. They were also under greater political and public pressure to provide answers and issue recommendations for a response. They sought out those answers, at least partially, by reading articles about the origins of H1N1 comparing the 2009 strain to its deadlier relatives – like the 1918 or 1957 flus. The potential for high transmissibility or severity was, as it were, all in the family of H1N1 viruses. One might be able to surmise what the 2009 A(H1N1) virus would be by comparing it to its other relatives, or by looking for family resemblances. Kinship here held out a deadly potentiality. Epidemiologists looked to the 'experts' in evolutionary virology to provide them with pertinent clues to deciphering how deadly the 2009 virus *might* be.

A bevy of scientific articles and analyses of the H1N1 genetic sequences were published in the first few months of the pandemic. In addition to their own personal experience and other data, the phylogenetic trees were used by the people I interviewed to 'guess' things about the flu. One clear worry was that the 2009 A(H1N1) viral strain might be a cousin of the deadlier H5N1 – or share some avian ancestry. Indeed, all pandemic strains are related to "bird flu" (Morens and Taubenberger 2010). The circulating 2009 virus was compared antigentically to other known strains and determined to be a product of frequent reassortment events (Bhoumik and Hughes 2010). By July, virologists had determined that: "The likely explanation for the origin of this novel H1N1 influenza virus is that a reassortment event occurred between the North American triple reassortant and the European swine influenza virus" (211). What counted for those making decisions concerning pandemic response, however, was that the 2009 virus did not share key characteristics of its deadlier relatives. The phylogenetic tree for

the 2009 A(H1N1) virus was shown to have "genetic roots" in the 1918 H1N1 viral strain; the virus that killed an estimated 20 million people was an "ancestor virus" of the 2009 swine flu (Science Daily 2009). What the 2009 virus didn't have, however, were the genetic "Jamesers for virulence that made the 1918 pandemic strain so deadly" (Silberner and Greenfieldboyce 2009). It is the comparison of known Jamesers that epidemiologists working 'on the ground' during a pandemic are especially eager to lay their hands on in the earliest weeks of a pandemic.

Although virologists like Sam Jones might warn against using such genetic Jamesers for predictive purposes, most of the public health officials I spoke to were comfortable basing their own personal predictions on such information. Such information was consistently viewed as an key part of decision-making during the early days of the outbreak. If the 2009 virus did not show any genetic Jamesers for increased lethality, then less drastic measure could be taken to mitigate the spread of the flu. If, however, the 2009 virus had shown Jamesed similarities to its 1918 ancestor, public health authorities would have erred on the side of greater caution by instituting more drastic containment measures to slow the spread of the pandemic. This 'guess work' was at the heart of the quiet debates over the uses of phylogenetic trees between evolutionary virologists and their counterparts within national and international public health agencies. The virologists were uncomfortable making any sort of predictions based upon the known RNA sequences; the epidemiologists and public health officials, on the other hand, were not so troubled by using such incomplete information to respond to what they saw as a potentially serious threat to public health. As Ruben Donis, the U.S. CDC's chief molecular virologist, stated in an interview for *Science* in May of 2009, the virus might have revealed a part of its complicated evolutionary history, but its RNA alone could not help to answer the question of its specific origins (Cohen 2009a, 701).

In other words, there was a 'natural' limit to what might be conjectured about the virus from information about its gene segments. The virus illuminated the connections between things at the same time that it concealed them. One might trace the virus's path, but would ultimately be left guessing at its origins. Had a pig farm worker from Canada infected pigs in Mexico with the virus? Had a virus from the United States traveled to Asia through the pig trade? Had birds and pigs come into contact in animal husbandry in Eastern Europe? In a very real sense, then, questions regarding the biological origins of an influenza virus remain inherently unanswerable. Yet even if the origins of the 2009 A(H1N1) virus itself remain hazy, what becomes perfectly clear by 'reading' phylogenetic trees is that disparate people, animals, viruses, and locations are all interconnected. The main characteristic of those global connections is, I argue, viral in nature.

Conclusion

Since Durkheim and Mauss, social scientists – and particularly anthropologists – have examined how social relationships affect the ways in which people structure or classify objects in the world. Pushing back against the "social" construction of classification systems, some aruge that "people did not create taxonomies to mimic the structure of social relationships; instead, they modeled their social relationship after their observations about the natural world" (Wright, 35). Yet, in many ways, this debate over

whether the "natural" world influences our view of the "social" world or the "social" world influences our conception of the "natural" world is best read as a problematic continuation of the all-too human habit of dichotomous thinking. What I hope to have shown in this chapter is the ways in which the "natural" and the "social" elements of kinship become imbricated in the ways scientists talk about themselves and the viruses with which they work. Using terms from molecular biology itself, I have suggested here that influenza viruses are not born sui generis out of larger economic, political or social processes, but are both created from and used to create the worlds in which they inhabit.

Taking my cue from Roy Wagner's description of kinship, the concept of *viral kinship* reflects the "flow of analogical relatedness" (623) within global public health, and highlights a "collective joining" of scientific institutions and influenza researchers as a creative act (624). Wagner's kinship takes into account the temporality of relationality, as I try to do here, as well as obviates the distinction between kinship being conceptualized as either a "natural" or a "cultural" system. Instead, Wagner suggests that "analogic kinship" operates in a "wholly symbolic conceptualization of things" (627). Or, rather, he begins his analysis with a "conceptual world" rather than with a "kinship system" (Wagner 627). As anthropologist Sandra Bamford has suggested, building her argument off of Wagner's analogic kinship: "Kinship is biology with culture put on top. It has to do with the social regulation of biological givens" (8). The phylogenic tree of the 2009 A(H1N1) virus should not be read as a mere symbol of the complex global forces that shaped its emergence and its spread; the microscopic 2009 A(H1N1) virus itself embodies those macroscopic forces.

For my own part, I rethink kinship here along microbial lines; instead of centering on human biological or cultural reproduction, viral kinship centers on viral reproduction and the cultural production of viral kinship charts. Relationality, in effect, has always been organized virally. Anthropologist Stefan Helmreich reminds us in his book on microbial life forms and marine biology, *Alien Ocean*, that "life is becoming unmoored from the boundaries of the organism into networks of connection" and "redistributed into a fluid set of relations" (8). The concept of viral kinship unpacks the ways in which a virus both connects things and is connected by them. Viral kinship, then, is still about relationships – or about relationality – but takes its organizing powers from the viruses themselves. Relationships organized *virally* are always in a state of flux and capable of shifting or reorganizing based upon environmental circumstances, events, or contact with another institution or network. Viral kinship is an analytical tool capable of helping me to link together disparate parts of larger organizational networks in a multi-sited field. Correspondingly, it is a way of conceptualizing the 'whole' from only a partial segment, as well as a method for examining a sliver of experience by seeing how it intersects with or 'fits into' the entirety of an 'event.' Here, however, it is also my method for making sense of the ways in which different persons, organizations and things (like information or viral samples) circulate and interrelate inside the structures that we typically think of as Global Public Health and Global Science. Learning to 'read' the genetic phylogeny charts of viruses might offer anthropologists a new way of thinking about materiality and the production of non-linear relatedness in the medical sciences and beyond.

Chapter Two

The 'Realness' of RNA and the Laboratory Science of Sequencing Viruses

> *Life is indifferent to the thingness of an object; it insists that every thing must be functional, fulfill some needs.*
>
> -- Hannah Arendt, *Between Past and Future*

> *Taken up by a well-integrated culture, the most ill-assorted acts become characteristic of its peculiar goals, often by the most unlikely metamorphoses.*
>
> -- Ruth Benedict, *Patterns of Culture*

At this point in the narrative of the biological origins of H1N1, we must make an important – and lengthy – divergence to depict the science of virology and the material practice of looking for and sequencing novel viruses. Turning soil and swab samples into information or knowledge about influenza is a lengthy and hand-on process. This invisible chapter, if you will, narrates the invisible practices that undergird much of influenza science. It is an attempt to explore – in brief – what a term like 'kinship' means in relationship to gene segments and scientific nomenclature (instead of in association to more typical things like maternal and paternal descent). Stefan Helmreich suggests in his work on marine biotechnology that laboratory techniques such as the ones I describe below are indivisible from "institutional apparatuses" (106) such as pandemic plans, WHO International Health Regulations, and the CDC's Emergency Operations. Knowing something, then, about the everyday science behind the production of phylogeny trees in evolutionary virology is integral to understanding – viscerally – how viruses and those who work with or are affected by them are interrelated.

As Bruno Latour and Steve Woolgar's seminal study of "laboratory life" (1979) first highlighted, it is important for any ethnographer of science to familiarize herself with the daily practices and lingua franca that scientists use on a habitual basis. As an anthropologist who studies viruses, infectious disease, and public health, I make concerted efforts to keep abreast of advances in microbiology and genetics. Even so, I was consistently made aware throughout my research that my grasp of 'basic' virology was incomplete – at best. When I began fieldwork inside a national health agency, a director with a background in virology sat down with me to discuss my research project and what I might be doing day-to-day in his unit. I said that I was interested in the viruses themselves, as well as in understanding the global public health network and in observing the daily activities of epidemiologists working in global disease surveillance and response, but that ultimately my own project would try to retell a multi-dimensional story about influenza pandemics from the cultural, scientific, and historical points of view. He nodded and asked me how extensive my training in biology had been, which courses I had taken "back in college." Afraid that I was about to lose all credibility, I told him the truth; I didn't have a formal background in biology. He stared at me briefly as though he were a concerned parent, then thoughtfully listened as I explained my master's thesis topic on retroviral remnants in the human genome. The more I explained the science behind my topic, the more visibly relaxed he became. Finally, he said, "OK, so you know

some virology. That's good. But if you have any questions about what we're talking about, just ask."

I ended up asking my fair share of questions concerning the science of sequencing influenza viruses while observing inside Professor Bruno Lau's laboratory in Hong Kong[12] in the spring of 2010. By that point, the genetic sequencing and completion of the genetic phylogeny for the 2009 A(H1N1) influenza virus was a fait accompli, and so what I had the opportunity to directly observe instead were some of the routine surveillance and sequencing activities that revolved around random sampling of soil collected from surrounding farms in either the New Territories or across the border in Guangdong Province, Mainland China. As I was repeatedly assured by the diligent post-doc who ran the day-to-day operations of the lab, however, the techniques I witnessed were the same standardized procedures used for the discovery and sequencing of viruses everywhere (including those performed in Robert Webster's lab at St. Jude's). The location of the individual laboratories and the physical origin of the samples might change, but the scientific practice was uniform. In essence, then, we will be observing the discovery and sequencing of the 2009 A(H1N1) influenza virus here by proxy.

The post-doc in charge of my time in the lab, Steven, lamented that most of the things I would have the opportunity to witness were quite boring and repetitive. "But when we find what we expect to find, or what we said we wanted to find," he said, instantly smiling and opening his eyes wider, "that's when it's really exciting. Then everything we do is worth the effort."

Most of the time, Steven cautioned me, they wouldn't find anything all that new or interesting in the samples. On a typical day, it would just be "routine" laboratory science. I sensed that Steven was a bit perplexed concerning my obvious desire to watch as he processed soil samples and sequenced influenza viruses. But it was specifically this routinized search for influenza viruses and the attendant material practices of the lab that I was interested in observing. Contra to Latour and Woolgar (1979), however, I initially had no trouble with conceptualizing a virus as a physical 'fact,' nor did I have any overweening interest in unpacking the practices of 'literary inscription' (45-52) or the social construction of viruses as 'objects' (128-129) in Lau's laboratory. Instead, *I wanted to take the science itself for granted* in order to better understand how the materiality of viruses and their material processing might be related to the construction or maintenance of a viral kinship.

Following Isabelle Stengers, I wanted to examine the paradigm that drives present-day virology as a "way of doing" or "intervening" (49) – not just as a way of "thinking" about viruses. While observing in Lau's lab, however, I began to think that what virology laboratories were constructing through these material processes was not – reductio ad absurdum – the virus itself, or even simply 'knowledge' about a virus, but rather a complex network of scientists, laboratories, farms, public health institutions and other 'actors' involved in the circulation of influenza samples and genetic information about influenza viruses. The laboratory, then, might be better conceptualized as

[12] Bruno Lau is an affectionate pseudonym for a scientist currently working on the influenza virus – as well as other zoonotic viruses – in Hong Kong. Bruno is a reference to Giordano Bruno, the famous heretic put to death for his unorthodox views during the Roman Inquisition. Unlike most of his contemporaries, Professor Lau does not believe that highly-pathogenic H5N1 is a threat to humans. He believes that his vocal support of this view has led him to be ostracized from the rest of the research community in the city.

constructing a new type of relationality between nonliving and living things, between humans and nonhumans, between individuals and social institutions. The standard laboratory techniques that I observed were, in essence, part of the infrastructure of global public health (Star and Lampland 2009). And as scholar Elizabeth Dunn reminds us so poignantly: "Although standards present themselves as *episteme*, as pure idea that exists outside of particular places, standards need an *oikodomi*, a material context in which they are transformed into action and effect" (120). The material practice of the lab techniques that I discuss below transforms the influenza virus into an artifact that is "simultaneously *ideal* (conceptual) and material" (Bowker and Star, 289).

Ultimately, however, I began to envision the laboratory as the site of an orchestral movement with a virus as its invisible conductor. If anthropologist Celia Lowe uses the 'cloud' as a metaphor "to indicate the clusters of biosocialities in play and at work with H5N1 in Indonesia" (627), then I use viral kinship as a lens for looking at the practices of lab science in Hong Kong. I explore how 'touching' the virus, manipulating it, and eventually 'reading' it, helps to build social and professional networks. This is perhaps less-than surprising, since scholars have already made the claim that standards and infrastructures are really about relationality (Lampland and Star, 17). One must learn standard lab techniques under the tutelage of other, more experienced, scientists. I was interested too, then, in the lab as a type of relational ecology – an environment that shaped those who worked within it.

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Professor Lau's lab was engaged in an ongoing effort to study longitudinal change in the genetic makeup of viruses found in soil samples collected from farms in the New Territories and Guangdong Province. The project involved the processing, genetic mapping, and analysis of viruses found in soil samples collected from the same livestock farms on a monthly basis. It was fortuitous, Professor Lau told me on my first visit with him, that his lab assistants would return from one of the farms the weekend before I was scheduled to observe inside the lab. I would have the chance to observe the entire process from start to finish – from soil sample to RNA. The particular group of soil samples I would be helping to process had been collected with sterile cotton swabs from soil surrounding a central pond and in selected random locations throughout a farm located in Guangdong Province.

After collection, the samples were deposited in clear, plastic test tubes with a transport material; the tubes themselves packed in ice and sealed inside a white Styrofoam cooler in order to preserve any biological organisms in the soil. The practice of collecting and transporting viral samples, I quickly realized, was the first instantiation of how a material or biological objects could connect disparate people and locations into a common network. The free collection of samples required a delicate balance between researcher and farmer. The personal relationships, developed over time and built on trust between particular farmers and particular researchers, had bled into the routine collection of samples. The practice had – over time – crafted a relationship or bond between farmers and the scientists. Professor Lau, in particular, felt a strong allegiance to the farmers; he had promised to never divulge their identity or location to the authorities, despite the fact that he was under continual pressure to do so.

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Part One – Discovery

The first step in the process assumes as its foundational premise that each soil sample is 'positive' for virus. In other words, all samples are initially presumed to contain live viruses of some indeterminate nature. That means, in essence, that all samples will be tested for confirmation of the presence of virus. Should a sample then be confirmed as positive for the presence of influenza virus through the process of polymerase chain reaction (PCR), then that virus will be cultured in a cell medium and its ribonucleic acid (RNA) genetically sequenced and compared to other known viruses.

Building on the work of philosopher John Searle, it becomes crucial to point out here that the viruses in the soil samples are both institutional and brute *facts*. Even if the virus as a fact is "observer-relative" or "ontologically subjective" (Searle, 10) throughout the testing and sequencing process, that does not mean that the virus cannot also be viewed as a 'natural' physical or material object that exists outside of virus-human interaction. There is a difference, as Searle suggests, between *constructing* objects to serve a human purpose and *assigning a function* to naturally-occurring objects (14). Therefore, I assume throughout this narrative retelling of scientific practice, that viruses are constitutive of both "agentive functions" – or intentional uses given to objects by humans – and "nonagentive functions" – or functions which remain independent of the "practical intentions and activities of human agents" (Searle, 20). Viruses, then, are "brute facts" that exist outside of our human knowledge of them – or their "literal inscription" in the virology laboratory (Latour and Woolgar 1979); viruses are also, and importantly, 'social' or 'institutional facts' that are the direct products of scientists' collective efforts. It is vital to view viruses in relationship to this interstitial position in order to effectively analyze what agentive functions or 'work' they do as the foundation of a multi-billion dollar global research paradigm.

Once I donned a borrowed white lab coat and stored my things under one of the work benches in the main lab, Steven guided me toward Professor Lau's Biosafety Level 2 (BSL-2) laboratory. We passed through a series of two heavy doors, separated by a short hallway cluttered with metal storage cabinets, and into an average-sized room. The room itself was painted white and packed with equipment: refrigerators; large, standing tanks I presumed contained some kind of gas; a few black swivel chairs scattered at the work benches; rows of boxes which contained tubes, pipette covers, rubber gloves; a set of stainless-steel sinks; and, the most important piece of equipment in the room, the hooded (or ventilated) work bench.

Almost instantly, I realized that I was in a room *that contained viruses*. Unexpectedly, I felt nervous only for a brief moment before my anxiety dissipated into an intense excitement. I had read about and studied potentially deadly viruses for years, but I had never *met* any of them in person. It was almost like meeting a favorite celebrity; I felt a fan's nervous anticipation and delight.

Steven opened the door of a mid-sized refrigerator to take out a small, clear plastic tray of cell cultures. All samples and cell cultures were kept in a refrigerator unit stationed inside the BSL-2 area of the lab at exactly 35.2 degrees Celsius and 5% CO_2,

Steven explained, because this temperature and CO2 percentage was the optimum level for preserving and culturing viruses. The tray in Steven's outstretched hand looked like an ice tray or a watercolor tray – with tiny wells in rows. Steven pointed to the configuration of cells, eight down by ten across, and explained that each column of cells contained the same dilution of virus, with each row of cells reflecting a different dilution of virus. Eight samples, then, would be at exactly the same dilution of virus (the purpose of duplication being to provide a control for the experiment). Different dilutions, Steven said, were used to determine the TCID50 for virus titer (or the concentration level of the virus which would lead to infection in fifty percent of the inoculated cells). As he was explicating these terms for me, Steven carefully taped the cell culture tray with a microfilm so that we would be able to transport the tray outside the BSL-2 area of the lab. The tape would trap any viruses inside the tray, preventing contamination outside of the BSL-2 area.

"I prepared this earlier for you, so you could see a good result. I already knew that there was virus in the sample I used to culture these," Steven said, leading me back out to the main lab and carving a path to a set of microscopes at a workstation. He said he wanted me to see what an infected cell looked like for myself. As he placed the tray under the microscope, I felt almost giddy. It was the closest I would get, without benefit of an electron microscope, to *seeing* a virus.

I took off my glasses and peered through the lens at the cell inside the tray well. As I did, Steven interpreted what I was viewing. First, he had me look at a negative sample – one without any evidence of virus. The uninfected cell resembled a series of light, banded lines. Then Steven repositioned the tray and told me to look again, this time at a positive sample – at a cell showing evidence of virus. Even as a novice, I could note the difference. Whereas an uninfected cell visualized itself as light lines, an infected cell had a more rounded appearance. Steven called this a "display of detachment" (or evidence of cell degeneration). Evidence of detachment was termed as cytopathic effect (CPE) and was used to calculate the TCID50.

It is important to fully admit that I had never heard the terms TCID50 or CPE before Steven first uttered them in the lab. Presuming I had at least a basic knowledge of virology, Steven used terms automatically. I had to stop him in mid-sentence several times, at least initially, so that I might be able to grasp everything he said. I scribbled words and acronyms down in my notebook as fast as humanly possibly while still trying to listen intently. Apprentice where Steven was expert, I rued not having taken any introductory microbiology classes. Everything was new and exciting for me; for Steven, however, these procedures were already rote. He was clearly operating on 'lab autopilot,' and I noticed him straining to slow down, to move more deliberately and consciously through all the routine steps involved in 'finding' a virus in a soil sample, to carefully explain the minute steps of the material processes to me. After I – finally – began to understand some of the terms myself, I felt elated. It was an incredible experience to see an influenza virus, or rather, to see the effects of the virus on a cell. It occurred to me that I was a witness in the scientific process of detecting a virus, separating it out, making it visible in the lab, and then sequencing it – all in a collective effort to make its origins 'readable.' The laboratory, a la Latour and Woolgar (1979) or Shapin and Shaffer (1985), really did make the invisible visible.

The entire scientific process for manipulating viral material in soil samples was both painstaking and precise. It required skill and practice in order to carry it out effectively, or to produce 'good' results. In essence, the steps that I observed in Professor Lau's lab produced the virus as a concrete or 'real' object that could subsequently be examined, studied, and further manipulated. The material process for extracting viral RNA from samples and then 'amplifying' them so that they could be genetically sequenced was even more lengthy and took repeat visits to the lab to observe from beginning to end. In what follows, I recreate the repetitive nature and ennui of the process through an exacting description of the physical steps necessary to produce enough viral material for sequencing. My point is to mimic these material processes for the reader, so that he or she may visualize and virtually experience the lab.

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Part Two – Discovery, cont.

Step one was to add a chemical reagent called TRIzol to soil samples in the test tubes. After this, the samples could safely be transported out of the BSL-2 lab, as the reagent neutralized (without 'killing') any virus in the soil. Plastic barrier tips were used to prevent contamination during the process. I watched as Steven used a new tip for each separate sample, which added to the length of time he spent working under the ventilation hood and made the BSL-2 area seem eerily reminiscent of a factory production line.

TRIzol, Steven explained, could extract both RNA (virus) and DNA (usually indicative of bacteria, but some viruses also have DNA instead of RNA) from the sample, making it an excellent reagent for use in detecting unknown microorganisms. Once the reagent had been added, Steven packed each tube in ice. Because RNA is easily degraded, he clarified, it was 'best practice' to keep viral samples cool at all times.

Back in the main area of the lab, Steven added chloroform to the reagent mixture. Each tube was then 'vortexed' for exactly ten seconds. When a tube is pressed against the vortex machine, it vibrates at a high speed, reminiscent of the way a sonic toothbrush operates. The mixture transformed from a clear pink to an opaque pink in color and was then incubated for exactly three minutes.

Steven set a kitchen timer and we chatted about life in the lab, about how interesting he finds his work, about how Hong Kong is the best place to do research on viruses. After three minutes, we walked the tubes over to a centrifuge, and ran the machine at 12,000xg for ten minutes. Our chatting continued.

Post-centrifuge, the mixture in each test tube had visibly separated out into three distinct layers. I noted how each step in the material processing of samples produced clear visual changes inside the tube. The pink bottom layer, Steven said as he pointed out the thick-looking substance gathered at the bottom of the tube, held any DNA viruses the sample may have contained. A thin white film on top of the DNA layer was the protein layer. Steven explained that the protein layer might be much thicker, depending on the type of transport medium used. At the very top was a clear layer, or 'aqueous phase,' that contained what we were looking for – RNA viruses. The viruses separated from the rest of the mixture due to differences in solubility.

At this stage, Steven began the process of collecting the upper aqueous phase into a clean test tube. While he was doing this, I took pictures over his shoulder. Steven

stressed that the pipette should not touch the other material layers inside the tube; if it did, it would contaminate – and ruin – the experiment. I watched as Steven collected all the aqueous phase that was possible without touching the pipette tip to the protein layer. In different experiments, the process would be much more difficult, Steven explained. If he was looking for mRNA (or messenger RNA), then the aqueous phase would be even thinner and he wouldn't be able to touch the DNA section or the protein interface because it would contaminate the sample – and the results.

Mid-way through the process, Stephen suddenly offered to let me try to pipette out the aqueous phase. He held the pipette out to me and I quickly demurred. Then we both laughed.

"It takes practice," he said. "Most students have no pipetting skill at first. We try to collect as much as possible because we don't know the virus titer – if it's low, then we'll need as much as possible."

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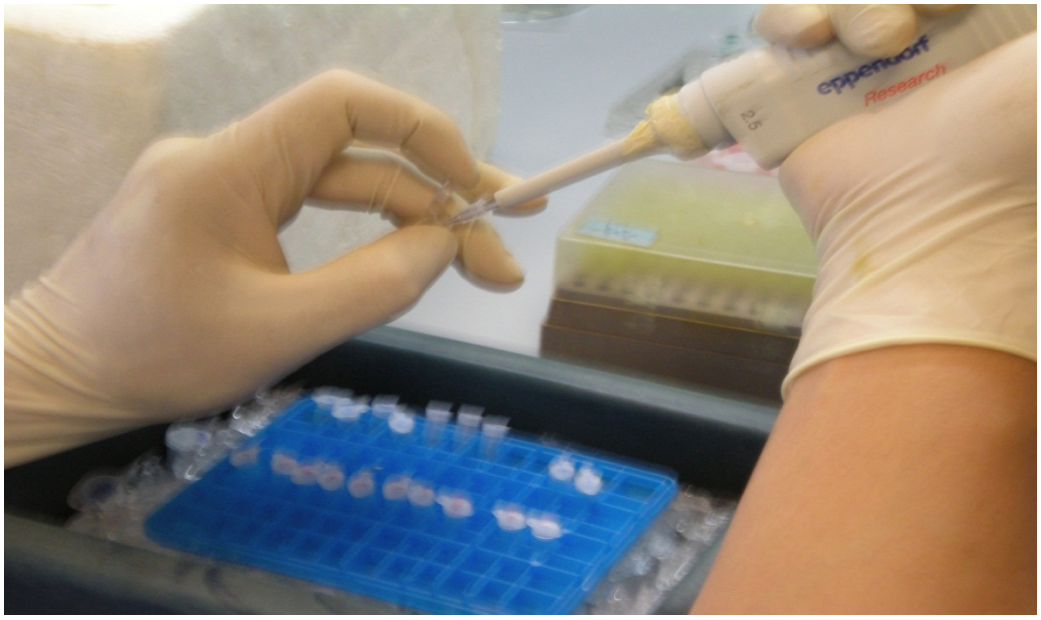

Figure 2: A display of dexterity. Steven's pipetting skill was almost flawless after 10 years of experience in a virology lab. The daily practice was part of a series of techniques required for success in the lab, forming part of a 'habitus' of laboratory work.

Part Three - Amplification

Steven added isopropanol to each tube and explained that this step was for the "precipitation of the RNA particles" – a process that aids in the discovery of virus particles even at low titer levels. After the samples were incubated for another ten minutes, they were placed back in the centrifuge for another ten-minute spin. The 'supernatant' – or liquid – was then simply poured out of each tube into a collection tub at the work station for waste disposal. Remaining at the bottom of the tube was a white RNA pellet. Steven clarified that the samples we were processing produced a particularly big RNA pellet, and that sometimes the pellet would be so small that it would not be visible to the naked eye. But even if it wasn't visible, Stephen said, the RNA pellet is

assumed to be there. A solution (EtOH) was then added to the pellet to remove any salt. The tube was given another 'short spin,' and the supernatant was aspirated (all the liquid was removed). After this, only the RNA pellet remained at the bottom of the tube. Finally, water was added to the tube to "re-suspend" the RNA pellet. Each tube was then individually vortexed to dissolve the RNA pellet. This was the end of viral RNA extraction, and where the process of complementary DNA (cDNA) synthesis begins.

I want to pause our narrative here to briefly discuss the concept of synthesis. At this stage of the material processing of viral samples, more virus must be produced – or the virus must be amplified – before the virus can be genetically sequenced. This is the physical beginning of what will eventually become information about the viruses genetic makeup and it genetic phylogeny. From the perspective of Actor-Network Theory (ANT), developed by Latour, Callon and others, the virus here is an 'actant' (itself a term used, in part, to move away from the divide between subjects and objects, humans and nonhumans). What is important in ANT is the *interaction* between humans and nonhumans and the networks that develop as a result of this human/nonhuman interface. This would require, Latour argues, that we "rethink anew the role of objects in the construction of collectives" (1993, 55). It is at this point, then, that I want to insert Searle's suggestion that biology and culture are not oppositional, but fused, and that "culture is the form that biology takes" (227). What Searle is arguing, rather provocatively and as read against Latour, is that there is a continuum between the ontology of biology and the ontology of cultural or institutional forms. I argued in chapter one that the network of virologists, epidemiologists, public health officials, farmers, vaccine manufacturers, and various other 'actants' are, as it were, born out of the biology of the influenza virus. As such, the network mirrors the characteristics and functions of the virus. Philosopher Karen Barad's concept of 'agential realism' suggests that it is in the 'intra-action' of object and human that produces the scientific object – or viral RNA. Her use of the term intra-action is a self-avowed attempt to move beyond the dichotomy of subject and object, suggesting instead that the object and the subject's 'observation' of it are indissoluble (Barad, 5). In other words, the virus being synthesized and genetically sequenced is *indivisible* from the scientist's grasp of it.

Part Four – How to Culture a Virus

Back in the BSL-2 area of the lab, Steven switched gears to show me what happens if samples are positive for virus. Saline is first added to the sample to 'sterilize' it. This step is referred to as sterilization, Steven clarified, even though the RNA virus itself is kept intact or 'viable.' The samples must be 'sterilized' before the virus mixture can be added to the cell culture. To do this, the virus mixture is filtered with what looked like a small, blue kitchen sieve with a 0.2 micrometer filter (small enough that most bacteria cannot pass through).

After filtering, the mixture is added to Madin-Darby Canine Kidney (*MDCK*) epithelial cells for culturing. To amplify the virus before it can be sequenced, Stephen explained, a culture medium is added to the MDCK cells and the viral samples to "maintain the Ph condition and to provide nutrients to the cell." The medium itself was bright pink, and I briefly pondered why the color pink was so pervasive.

Steven dumped the medium out into a collection jar and tapped the petri dish onto a paper towel on his right, with all work being done under the ventilation hood. He rinsed the petri dish with a saline solution to get rid of any metabolic waste from the cells that might inhibit virus proliferation. After blotting, he added the virus to the dish. To the untrained eye, the petri dish looked 'empty' – or perfectly clear. I had to simply 'believe' or trust that the cells were there, clinging to the bottom of the petri dish, since I could not see them. Wittgenstein's postulation that all certainty was subjective (33e) flashed through my mind.

Steven explained that a large volume of virus was never added to the petri dish because a large volume of virus would reduce an individual virus's chance of cell attachment. Therefore, a small amount of virus was always added to the dish. The petri dish was then placed into an incubator for up to two hours. After incubation, another 10ml of medium was added to foster virus growth in the cells. Finally, the culture was placed back into the refrigeration unit for five days. Four to five days was enough time, Stephen explained, for the virus to grow and for the cells to show cytopathic effect.

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Part Five – Ascertaining the TCID-50

After the virus has been cultured, the next step is to dilute the viral samples in order to ascertain at what dilution 50% of the cells exhibited CPE. This information would then be used to calculate the TCID-50 for the virus. The tray itself was rinsed with saline to reduce cell waste (with each well having initially contained MDCK cells and medium), and the virus was applied to cell surfaces with 20ml of virus solution added to each well. The control row wells contained pure medium (without virus). Each dilution of the same sample was carefully labeled by Steven with -1 through -10. In other words, -1 stood for a concentration of 10X dilution, or 270ml of saline. The next column was labeled -2, pipetted from the original sample into another well with 270ml for a 100X dilution, and so forth.

Diluting the virus, Steven worked back from the lowest to the highest concentration because he wanted to utilize the same pipette tip. Doing this in reverse would have ruined the dilution and 'screwed up' the TCID50 results. As I watched over his shoulder, he made at least two mistakes – or near mistakes – when adding the solution to the wells. It was nearly impossible for either one of us to keep track or to tell if a mistake had really been made; the already filled wells showed only a light pink color from the medium, and were almost indiscernible from the clear, empty wells.

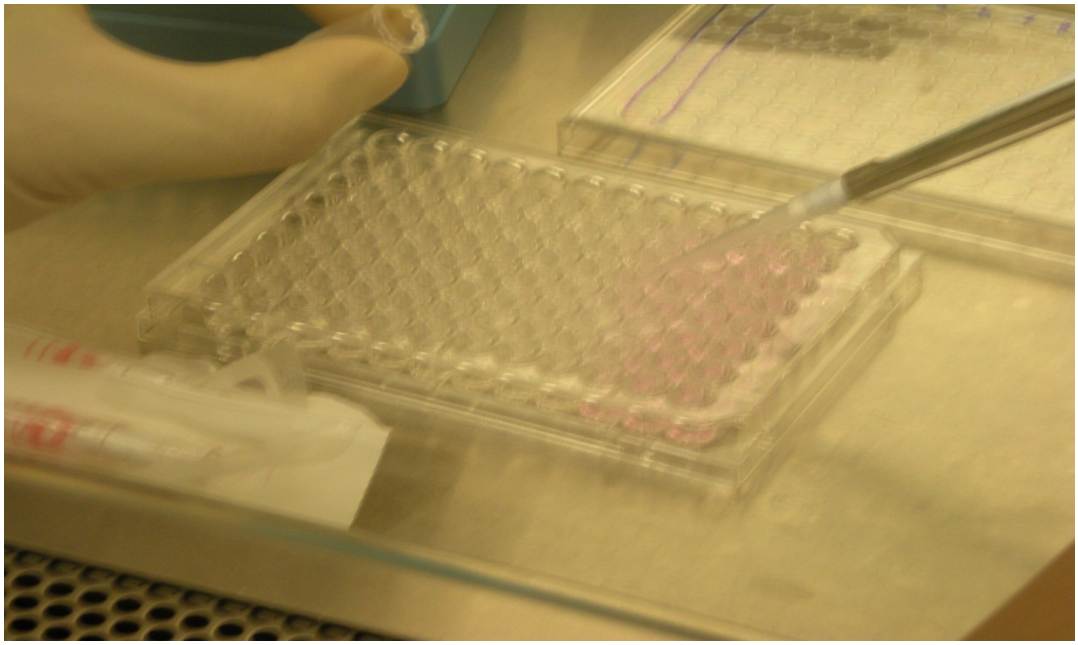

Figure 3: Dilution of viral samples.

After he was done, Steven placed the tray in the incubator for another two hours. Then, using a vacuum that funnels off residual material through a bleach solution to kill any leftover virus, Steven suctioned off the medium from each well in the tray. The tray was then rinsed with saline to get rid of any unassorted virus particles (or virus that have not attached themselves to the surface of the cells), which might throw off the results.

At this point, most of the viruses had merely attached to the cell surface, but had not penetrated the cell wall. The tray was incubated for two hours because Steven did not want the cells to become infected at this stage, as that might negatively affect the attachment rate for other viruses. Steven explained that once a virus had penetrated a cell, the virus alters the cell's makeup to make it more difficult for other viruses to attach or to penetrate the cell. In essence, Stephen was describing a viral competition for available resources.

After another two hours, the wells were suctioned once more after being rinsed with saline. Steven then added more medium and placed the tray back into the incubator for another four or five days. This time, however, he wanted the cells to become infected by a virus, as that would produce the cytopathic effect he was hoping to observe in order to calculate the TCID50.

The end result of this procedure was a cell tray with rows and columns of wells similar to the one that I originally looked at under the microscope on my first day observing in the lab. I had, as it were, come full circle in my observational cycle. I was back at the point where I had started, and I began to experience a bit of the monotony inherent to all 'normal' or 'routine' laboratory work. Once the trays had incubated, each well was checked and the results were observed on a chart.

Figure 4: TCID50 chart.

Part 6 – Reverse Transcription

In order to do anything further with RNA viruses, they have to be turned into DNA through a process of reverse transcription. This process takes place in a Polymerase Chain Reaction (PCR) machine, also interchangeably referred to as a thermocycler. A special 'reaction reagent' mixture (a composite of two DNA primers) was added to the viral RNA (or the end product of the process of RNA extraction above), using the DNA primers as a template for the PCR machine. Two different primers were used during PCR to reduce any chance of false negatives. Sometimes even when using two primers, Steven said, he would get a negative result. If there was no 'PCR hit,' there might still be an influenza virus present in the sample, but it would be something unknown or very rare. Using two primers, however, usually insured that he would get a 'hit.'

During the times that I observed him, Steven processed eight different samples, plus a positive and a negative control sample. The positive sample was a 'known entity' that produced a specific band of DNA. The negative sample was a reagent mixed with water. This was an important step, Steven explained, because the positive and negative controls would confirm if the reaction worked (i.e. when there are no positives from samples, but the positive control still shows a positive result), or if there was a possible contamination (i.e. when everything shows a positive result and the negative sample also shows a positive result). After adding reagent to each sample, Steven added a single drop of mineral oil to each tube to protect against evaporation during the temperature fluctuation in the PCR machine. Steven then explained that thermocyclers usually have a preheat function to help prevent evaporation, but that Professor Lau had found that oil was more effective in preventing evaporation.

After preparation, the samples were placed back in the incubator at 42 degrees Celsius for 50 minutes. The final tubes with samples and reagent mixture were then placed into the 'DNA Engine,' or thermocycler.

Figure 5: Lab assistants working with the thermocycler, or PCR machine.

Stephen explained to me that there were different phases to each 'cycle.' In phase one, the tubes were heated to 94 degrees Celsius for two minutes to activate the enzymes in the reagent. In phase two, the tubes were kept at 94 degrees for 10 seconds to denature the DNA double molecule. In phase three, the temperature was lowered to 55 degrees for 10 seconds to immune the primer onto the DNA template. In phase four, the temperature was raised back up to 72 degrees for 10 seconds to "turn on" the enzyme that elongated the target DNA molecule. In phase five, the process reverted back to step two. Steps two through five were then repeated for a total of 35 complete cycles. In the very last cycle, the samples would be kept at 72 degrees for 10 minutes to allow any gaps between the DNA strands to be filled in (just in case the elongation process had been interrupted). The machine was usually left to run on its own and the length of time it took to complete an entire 'run' depended on the length of the DNA product. The particular runs I observed took approximately one and a half hours to complete.

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Part Seven – Gel Electrophoresis

After PCR, and in order to 'visualize' the PCR product during gel electrophoresis, green dye was added to the samples. Steven pipetted the DNA strands from the tubes collected from the PCR machine, making sure to go through the oil layer to the DNA layer beneath, and mixed each sample with green dye. A positive and a negative control were also run through gel electrophoresis. For comparison, Steven placed a molecular Jameser (with well-known molecular weights) in between the sample and control wells.

Each sample was carefully added to a ‘well’ in the gel itself. I snapped a few photos of the wells, but I could not capture accurately just how tiny they were. A steady hand and excellent pipette skills were a must at this stage, otherwise, the gel electrophoresis results would be compromised. I felt nervous just watching Steven pipette the sample into the gel.

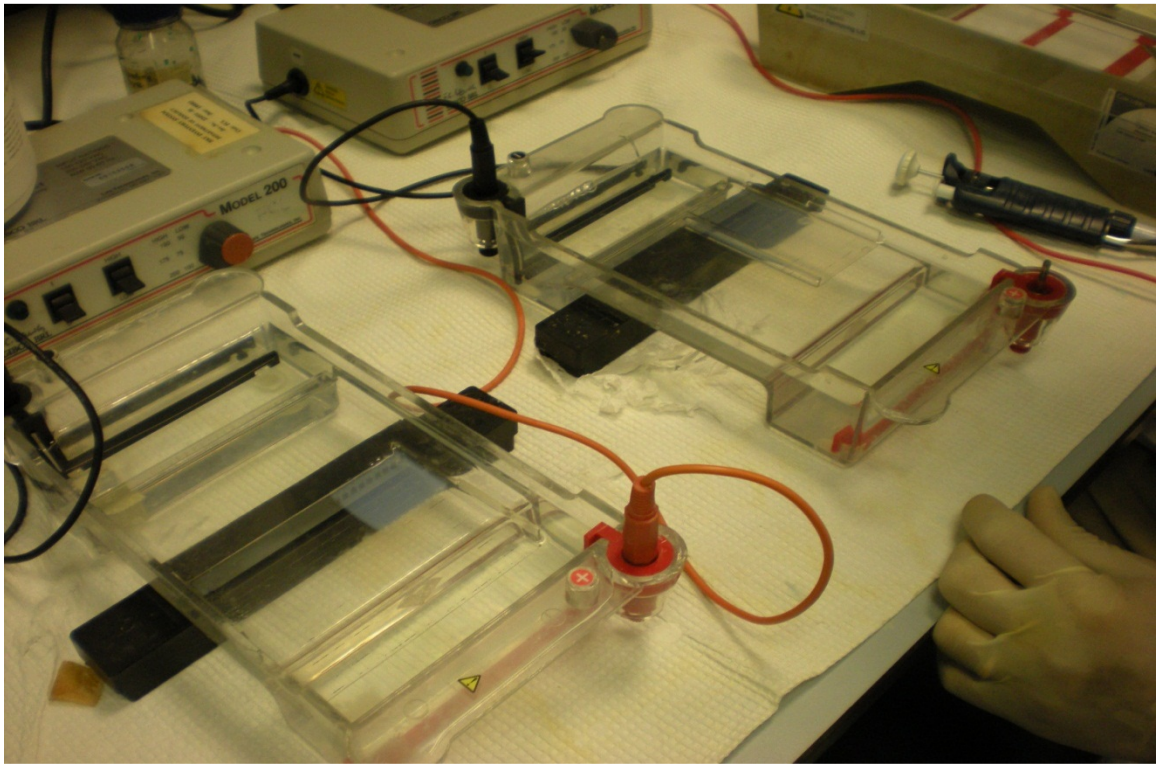

Figure 6: The gel electrophoresis stage.

An electric charge is run through the gel for 45 minutes, time enough to allow the DNA molecules (which themselves carry a positive charge) to ‘migrate’ through the gel. After electrophoresis, the gel is then stained with ethidium bromide – a highly carcinogenic chemical – that binds onto the DNA molecules (this procedure is often called ‘florescent tagging’). Steven then placed the gel, using a common kitchen spatula, into a ‘gel dock,’ which generated a picture of the DNA bands.

Steven reminisced that when he first began to work in a microbiology lab, they had still used Polaroid pictures in this step. He was happy, he said, that everything had since been digitalized. In the gel dock, the samples were compared to the molecular Jameser, and one turned out to be positive. All positive samples in Professor Lau’s lab are fully DNA sequenced.

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Part Eight – DNA sequencing

The DNA sequencer was located one flight down from Professor Lau’s lab in the same university building, housed in a secure, coded room. Stephen told me that it usually

took about 1.5 hours to run 800 base pairs, but that 16 separate samples could be run concurrently to save time. Steven told me that Professor Lau liked to sequence the full

Figure 7: Professor Lau's DNA sequencer.

genome of most positive samples, because he believed that a better understanding could be had by doing so, rather than by just sequencing certain genes or gene segments of a virus – still standard practice in most other labs.

When I asked Steven what his favorite part of the entire process was, he replied: "Getting results that fit your hypothesis is the most satisfying, but it only happens in about 20-30% of the experiments. The rest – the failures, so to speak – are used to restructure our hypothesis. But it is nice when you see what you expect to see."

When I asked Stephen whether or not it was difficult to get farmers to understand their work and to collaborate in the collection of various types of virus samples, he nodded. It had been difficult to convince farmers in the New Territories to allow regular sampling, but after SARS and avian influenza outbreaks, the surveillance had been legally enforced. It was far more difficult, Stephen said, to collect samples from farms on the Mainland.

Professor Lau had described the situation to me during one of our conversations; the only reason farmers allowed Professor Lau to regularly collect samples was that the exact location of the farms was concealed. "They trust us," Professor Lau said. "We understand that they don't want their livestock to be slaughtered. Over the years, we have developed this good relationship with the farmers, so they let us collect our samples."

The virus samples were already connecting otherwise disconnected individuals. The relationship between the farmers and the scientists in Hong Kong was described as ‘close’ and as necessarily ‘familiar.’ The exchange of material and useful information prompted a feeling of trust to develop. Particular farms were seen as working with particular labs in a type of trust-based relationship. The materiality of the virus samples was being transformed into a type of relationality built upon the virus itself. The end product of a laboratory in Hong Kong – genetic information on influenza viruses – circulated widely and helped to expand kinship out to include other labs, other farms, other institutions, and other countries.

Chapter Three

"Hong Kong is China": Cultural Politics, Identity, and Influenza Science

Hong Kong did not exist, so it was necessary to invent it.
– Richard Hughes, 1968

March 2010 - Hong Kong, Special Administrative Region, China

The Hong Kong side, or simply 'the island,' is a verdant, if condensed, location. Only approximately 300 square miles in actual surface area, and much of that consisting of green, sub-tropical parks, the island seems much bigger than it is. In part, this is directly due to Hong Kong's genius for packing a lot into a small amount of physical space. The modern commercial and residential buildings rise out of the earth and puncture the almost daily cloud cover, a whole city of metal spires reaching forever upward. Upward is the only real direction to go.

This mirrors, of course, Hong Kong's obsession with stock Jamesets and trade. Created as a trading center over 100 years ago, Hong Kong retains its birthright as a bustling port for people, money, and goods. It is a city continuously in transit and is hard to pin down. Its residents are forever pontificating about Hong Kong's future: Whither Hong Kong? This has become especially acute in the past few years, as the rise of mainland China has placed other Chinese cities in direct competition with it. Shanghai especially creates much of the existential angst that Hong Kong is experiencing in the 21st century. Hong Kong was the first Chinese city to be internationally competitive, but it knows that it is not the last, that it cannot be, and that it must be a leader for China. Hong Kong worries that it will not keep up with the pace of growth and change on the mainland, and that it is not enough to be riding on the coattails of a giant. Hong Kong wants to be the head of the dragon, not its tail – as is evidenced by the recently redesigned logo for the city.

Figure 8: Hong Kong's redesigned logo, emphasizing its position as an international city. The use of Chinese characters and the symbol of the dragon, however, signal its 'Chinese' characteristics. The positioning of Hong Kong directly over the head of the dragon suggests that Hong Kong is leading the rest of China forward – toward progress.

I categorize Hong Kong here as a Chinese city because it is. It may also very well be Asia's 'international' or 'world city' and a thriving former British colony, but that is only part of its collective history. To suggest that Hong Kong is not *Chinese enough*, that because of its complex history it is more Western than not, is to almost miss the multifarious character of the city entirely.

During my time in the city, from 2003 until late 2006 as an expatriate resident, and then again throughout the spring of 2010 as a researcher, I often heard Hong Kong citizens and long-term denizens alike lament that: "Hong Kong is more British than the British." This statement signified both as a dirge and complaint. It was uttered by both Chinese 'natives' and by Western 'transplants' or 'expats.' That one, single sentence seemed to contain the hopes of all Hong Kong's various residents that the city would become something different from what it had been, that it would become less 'British' and more . . . what? Chinese? Asian? Global? More like itself – more Hong Kong-ish? It was always the latter sentiment that seemed to prevail.

Hong Kong thinks of itself, by and large, as a unique city. In fact, this attitude is so widespread within the SAR that I might argue that 'uniqueness' is a universally-held cultural value there. Hong Kong, the local logic goes, is nothing if it is not exceptional, special, different from, and more than. And this uniqueness must be upheld, nurtured, protected, safeguarded against all detractors and competitors, and at all costs. The overriding public fear that Hong Kong's distinctive character might be irrevocably lost as it becomes absorbed into China and forced to compete with other Asian cities for foreign investment has generated a general anxiety reflected in all aspects of daily life in the territory. Hong Kong is famously a betting city, and the long odds on Hong Kong retaining its uniqueness seem to shift with the prevailing winds that govern life on the Island. But in general, optimism seems to prevail. After all, Hong Kong not only survived the handover in 1997 from British to Chinese rule, it flourished. Hong Kong is a lot like the bamboo scaffolding that covers the outside of buildings being repaired or constructed in the city: frail-seeming compared to its giant neighbor and yet surprisingly, almost impossibly or miraculously, sturdy. Hong Kong is – and has always been – a space conducive to innovation, ideas, technology, and capital. Things cannot flow through Hong Kong without being shaped by the city and its people in the process. Only one bet is certain – that Hong Kong will continue to be an important hub for trade and cross-cultural exchange.

For decades, Hong Kong was one of the only places where foreign researchers could freely conduct China-focused research. It grew into a unique field site for a bevy of studies on China's social, economic and political structure, on its institutions and traditions. Today, however, most sinologists and other social, economic and political researchers have since moved on to greener pastures across the border on the Chinese Mainland. Hong Kong is no longer synonymous with 'China' or a flourishing center for 'China Studies.' Since the opening of the Mainland, Hong Kong has all-but been abandoned as a place of serious research on China.[13] This is, as it were, an error in 'over correction.' Why discontinue study in Hong Kong, especially when there is such rich

[13] An internet or library search produces very little scholarly texts or popular literature written on Hong Kong after the late 1970s. In the Anthropology Library at UC-Berkeley, in the fall of 2010, the available books written about any topic in Hong Kong took up less than half the space on one three-foot shelf. Books on Japan, Korea and China – in comparison – took up an entire aisle of space.

historical data to mine, such a long and luminous lineage of work already done, such a solid foundation for deep analyses of social phenomenon? In the ebb and flow of academic fashions, Hong Kong is no longer a 'sexy' place, topic, or field of study.

This 'fact' was driven home for me while I was there doing research on influenza science, surveillance and public health response. Whenever I explained to someone visiting the city why I was there myself, I invariably heard a similar refrain: Why not go to Beijing if I wanted to learn about China's way of doing things? Wasn't Beijing more important? This response was not limited to individuals unfamiliar with Hong Kong. I had a hard time convincing some of my fellow scholars researching topics on the Mainland that ethnographic investigation in Hong Kong was equally important. My friend 'Monique' summed it up best when she told me over dim sum that she adored Hong Kong, that it was her "favorite SAR," but that she would never do any of her actual research there.

"I need a job," she stated flatly, shrugging her shoulders. "The Mainland is more interesting to people."

The implication was clear. Do research in Hong Kong and leave yourself out of the China game altogether, one of the biggest areas of research in the world. And as I had already discovered, the funding Jameset for an academic doing something on the Mainland was hot. By choosing to study Hong Kong instead of the Mainland, I began to realize that I might be leaving myself vulnerable to the accusation that I wasn't doing real 'China Studies' at all.

"This *is* China," I said, succinctly arguing my case.

"You can do your interviews here in English," Monique said, grabbing a pork bun with her chopsticks. "Things are published in English and Chinese and this is, basically, still a British system."

Détente. We ended the conversation by agreeing to disagree. I would take my chances on Hong Kong; Monique would do the bulk of her research in Beijing.

Clearly, I had lived in Hong Kong too long. Maybe I identified, in some real and lasting way, as a Hong Konger. Maybe I had become infected by some of the rhetoric surrounding the city's uniqueness. Or maybe it was a mistake in 2010 to use Hong Kong as a proxy for China. Even so, I didn't think that the question of Hong Kong's 'Chineseness' or its interstitial position should matter. Hong Kong is as 'Chinese' as it is 'global' or 'transnational.' In the past, it was a testing ground and base for British rule in Asia. Now, it is a staging area for the Chinese government, a place where new policies and approaches can be given a trial run (think universal suffrage in 2020). To ignore – willfully or unintentionally – what happens in Hong Kong would be foolish.

The age-old problematic of whether Hong Kong is 'Chinese' or 'Western' is, in many ways, a dead letter subject. And yet, the city remains vitally important in our larger quest to understand what it means to be Chinese *and* global in the 21st century. Hong Kong is not, as some suggest, a modern-day petri dish for mixing East and West; it's a weather vane that points to the future direction of social, economic and political policy in China. Hong Kong not only remains one of the biggest keys we have to understanding and studying China, but to understanding and studying ourselves in the midst of an increasingly 'global' age.

In what follows, I will examine Hong Kong's reputation as a diseased space, or 'natural reservoir' for infectious disease, and how the city became an early laboratory[14] for scientific research on infectious disease. From the plague to SARS to influenza, I examine how disease outbreaks in the city were catalysts for the development of scientific research centers and new public health systems. I will then explore Hong Kong's so-called identity crisis following the 1997 handover of the city from British to Chinese sovereignty. The language of identity bleeds into the ways in which scientists and epidemiologists working on influenza in Hong Kong talk about their work in relationship to national and international scientific and public health networks. Finally, I analyze how a reemergence of the Chinese/Western binary in the scientific realm relates to Hong Kong's official policy decision to quarantine during the early weeks of the 2009 H1N1 pandemic. Hong Kong's experience throughout the pandemic was not only indicative of its interstitial position between worlds, but performative of it. If Hong Kong's use of quarantine – and subsequent defense of its quick and aggressive actions to halt the spread of the influenza virus – highlights the ways in which Hong Kong is realigning itself with China as a 'Chinese' city, then the high quality of Hong Kong's scientific research on infectious disease, and its trusted role in emerging global public health networks, highlights the ways in which the city aligns itself with the 'West' and maintains its position as an 'international' or 'global' city. Debates over quarantine and school closures help to delineate how the boundaries of the WHO and the U.S. CDC's influence on local or national health policies are being redrawn. Local and national 'beliefs' about influenza and different cultural expectations regarding outbreak response lie at the heart of understanding the resultant international deliberations over the relative effectiveness of quarantine and school closures.

I argue that these debates over Hong Kong's response to the 2009 H1N1 pandemic function on two levels simultaneously: the first is the level of 'science' or epidemiology and deals with the interpretation of data and the 'local' production of meaning; the second emerges out of the history, positionality, politics, and cultural identity of Hong Kong as a 'postcolonial' and 'international' city and so-called origin of influenza pandemics. Hong Kong's history as a 'floating city' with a fluid or 'floating' identity – a city and people conceptualized as effortlessly shifting between 'Western' and 'Chinese' systems and values – has produced a greater flexibility in response to outbreaks. More importantly, however, Hong Kong's floating identity has been critical in effecting its larger transformation from a *source of disease* into a *disease resource* for scientific research. Ultimately, Hong Kong's response to the 2009 pandemic suggests that cultural politics continue to play a large role in recent 'global' attempts to adjudicate or define 'normal' practices for global public health in the 21st century.

[14] My use of laboratory here, in many ways, owes homage to and is a continuation of Warwick Anderson's wonderful examination of how the Philippines became a "laboratory of hygienic modernity" (3) for American colonizers at the turn of the last century. His historical analysis of tropical medicine, leprosy, and the politics of public health interventions in his book, *Colonial Pathologies*, was highly influential to my early conceptual work for this chapter.

An International Petri Dish: Hong Kong's History as a Laboratory for Disease Research

> *Not everything happens in Hong Kong. But Hong Kong has samples. If you look at the influenza strains in North America, whatever happens in Hong Kong is six to eight months ahead of North America. Always. And that's the only reason why – and this is my own guess – that the National Institutes of Health (NIH) funds so much of the surveillance system in Hong Kong. If you dig, I'm sure that there are some historical accounts for that. . . . I don't even know where to start and where to end.*
>
> -- Bruno Lau[15], research scientist at the University of Hong Kong

Hong Kong as a veritable hub for international scientific research on infectious diseases has a long and rich history. After Yersin's pivotal discovery of the plague bacillus in Hong Kong during the last decade of the 19th century, the city was quickly conceptualized as a potential research mecca for those scientists working on bacterial or viral disease. The creation of a government institute dedicated to bacteriology – complete with a fully-equipped research laboratory – merely helped to cement Hong Kong's new standing as a unique site for research.

More recently, Hong Kong has been the site of the discovery of a unique strain of avian influenza capable of crossing the bird/human infection barrier (H5N1), and the Sudden Acute Respiratory Syndrome (SARS) coronavirus. Subsequent to the 2003 SARS outbreak and in response to its periodic outbreaks of avian influenza in both chickens and humans, Hong Kong has become universally recognized for its development and implementation of cutting-edge disease surveillance and response systems. Research laboratories located throughout the city have also developed a global reputation for the high caliber of their research on swine, avian, and other strains of novel or emergent influenza viruses. In this section I will argue that Hong Kong's more recent experiences with influenza and its evolving reputation as an important center for influenza research can – and should – be viewed as contingent to its not-so distant past as an international petri dish, or mixing ground and incubator, for infectious disease. Analyzing Hong Kong's history as a naturally 'diseased' city will help to highlight how the city itself has become such an integral part of the maintenance and operation of present-day global disease networks, particularly in relationship to SARS, influenza surveillance, and the development of global pandemic policies.

From the very beginning of its British colonization, Hong Kong's so-called naturally disease-prone environment – its year-round humidity and swampy, tropical marshland – was conceptualized as an immense problem for its colonizers. The opening sentence of scholar Faith Ho and The Hong Kong Museum of Medical Sciences Society's account of the history of infectious disease in Hong Kong is a quote taken directly from a travelogue on China first published in 1849. It reflects its British author's opinion, based

[15] All names of persons and institutions have been changed or withheld due to privacy concerns. Influenza science is a small world, so to speak, and I have made every effort to conceal the identities of those with whom I worked and interviewed. Bruno Lau is an affectionate pseudonym for a 'heretic' scientist currently working with the influenza virus in Hong Kong. Bruno is a reference to Giordano Bruno, the famous heretic put to death for his unorthodox views during the Roman Inquisition.

upon years of extensive travel throughout the Middle Kingdom, that Hong Kong in the 19th century was unconditionally "the most unhealthy spot in China" (Ho 2006, 17). Hong Kong was seen as a reservoir – or pit – of disease. The Medical Sciences Society's truncated history examines the British authorities' prolonged battle with infectious disease in the new colony. Most troublesome to the Brits, it seemed, were a collection of diseases generically labeled as 'Hongkong fever' (Ho 2006, 19). Assumed to refer primarily to malaria, Hongkong fever killed troops by the hundreds. Hongkong fever was so serious and so rife, that its occurrences eventually convinced the British government to take particular pains to stamp out disease in the colony. Hospitals were built and Western medical authorities were brought in to cope with a seemingly never-ending series of infectious diseases – each wave of which threatened to overwhelm Hong Kong's British and Chinese inhabitants and destroy the new colony's bustling economy.

Although Hong Kong was certainly no stranger to disease, as Faith Ho points out, it was ultimately an outbreak of plague in 1894 – the virulence and persistence of which was blamed on the unsanitary conditions of the Chinese quarters in Tai Ping Shan – that was the catalyst for the establishment of what would evolve into Hong Kong's first research center – the Bacteriological Institute. The severe outbreak of plague in the active trade port attracted the interest of the entire international community – including a group of Japanese and French bacteriologists. Merely a decade past Koch's discovery of the tuberculosis bacillus, germ theory remained a relatively new science. The outbreak of plague in the Western District of Hong Kong Island, then, provided a unique opportunity for bacteriologists trained in the methods of Pasteur and Koch to investigate whether or not a particular disease agent was the definitive cause of the disease. Acting on the authority of the British government, Japan sent a team of scientists to Hong Kong to investigate. During the same timeframe, Alexandre Yersin, a French national working for the newly established Pasteur Institute in Viet Nam, heard about the outbreak and traveled to Hong Kong with support from the French government, but without the official consent from the British authorities. The scientific race to isolate the plague bacillus began almost immediately. And although the Japanese team 'won,' the credit for the discovery of the bacillus went to Yersin – whose scientific description was deemed 'more complete' than his Japanese adversary. Here, we see the pull between East and West through the narrative of the bacillus's discovery. Perhaps unsurprisingly, the plague outbreak itself had highlighted the brewing tensions between the British and Chinese residents by pitting Western and traditional Chinese medicine against each other (Ho 2006, 31). Since the British authorities were ostensibly able to control the plague – if not to eradicate it outright, the outbreak is also conceptualized as an entrée point that allowed Western medicine to gain a foothold in Hong Kong.

The plague outbreak in Hong Kong lasted for 30 years and caused over 20,000 deaths. A commemorative booklet on the outbreak – for sale at the Medical Museum in commemoration of the 100th anniversary of the founding of Hong Kong's Bacteriological Institute – details how persistent outbreaks of the plague disrupted Hong Kong's economy (Ho 2006a, 17). Thus, the plague became an issue of critical importance for the British Government in the colony. As a port, Hong Kong was an integral part of the overall British economy; plague threatened to close the port to traffic and halt the lucrative flow of goods. Due to the continual outbreaks of plague in the city, the governor of Hong Kong determined that what the colony needed was "a laboratory for original research"

(Ho 2006a, 18). Patrick Manson, considered by many medical historians to be the father of tropical medicine, was an early promoter of the development of "first rate clinical and research work in medicine and public health" in Hong Kong (Ho 2006, 20). According to Ho, Manson was desirous that Hong Kong become a "Centre for Science for the whole of China and not just a center for merchandise" (2006a, 20). Manson convinced a brilliant bacteriologist working in London, William Hunter, that Hong Kong held a multitude of research opportunities for disease. Hunter agreed to relocate to the colony to set up the city's Bacteriological Institute.

The Bacteriological Institute was originally opened in 1906, and built upon the same site as the demolished Tai Ping Shan district, razed during the plague outbreak of 1894. A solid, colonial-style building, the former Institute still feels imposing. Its structure – a big, red brick building with three floors – has the effect of feeling both institutional and 'home-like.' The Bacteriological Institute's main tasks were plague surveillance and vaccine production, and left little actual time for the conducting of original scientific research. The Institute's additional role as the city's mortuary, however, eventually led Hunter to the realization that the bodies of deceased Hong Kongers[16] might provide him with a "wide range of disease conditions" for study; the city's morgue thus concealed a "rare research potential" (Ho 2006a, 50). Using tissue samples obtained from the mortuary, Hunter started a pathology museum that was eventually used to train Chinese medical students at The University of Hong Kong (Ho 2006a, 59). One early researcher at the Institute wrote: "'If the newcomer is a Pathologist, he will at once be struck by the abundance of material to be found in the Public Mortuary daily. . . . The opportunities for original research are practically unlimited'" (Ho 2006a, 63). At the end of the booklet, Ho argues that the Bacteriological Institute was a "forerunner" of the Centre for Health Protection (CHP), as it had "been brought into existence in response to the plague outbreak, in the same way that the latter was brought about in response to the SARS outbreak" (2006a, 86). This parallel between institutes and time periods would be made visible, too.

When I visited the Bacteriological Institute in the spring of 2010, the main exhibition detailed Hong Kong's triumphant experience with SARS. The exhibit materials stressed the successes of Hong Kong's public health system and lionized, in an echo of Yersin's story, the top virologists who discovered the SARS corona virus. Except that unlike in 1894, the scientists were 'native' to Southeast Asia, hailing from Sri Lanka and Hong Kong. Hong Kong's display of pride in its infectious disease research and surveillance capacity, while not unfounded, is an interesting counterpoint to its history as a 'diseased' city. Hong Kong has learned to utilize its conceptualization as a place rife

[16] Disease here is located by the colonial administration within the Chinese body itself. The lived-in bodies of the Chinese are transformed, after death, into mere repositories of disease. The 'Chinese body' here is instrumentalized through the medical gaze of 'Western' researchers, stripped of all its social, economic, cultural, and gendered aspects in order to transform multiple 'bodies' into a 'blank' site for the study of bacteriology. Nancy Scheper-Hughes and Margaret Lock, in their article "*The Mindful Body: A Prolegomenon to Future Work in Medical Anthropology*", argue that there are in effect three distinct bodies: the individual body, with its attendant phenomenology; the social body, which is the domain of symbolic and structural anthropologies; and the political body, tied to Poststructuralism and Foucaultian notions of biopower. In the rhetoric that constructs the Hong Kong body as a disease resource above, there is no easily locatable 'individual' body – and no semblance of the embodied or 'lived' experience of illness.

with disease to its own advantage. Disease, one might argue, has become one of Hong Kong's natural resources. Its access to viral and bacterial samples has guaranteed Hong Kong a permanent position in the developing global disease networks, at the same time that such access grants its local researchers and scientists an unparalleled opportunity for innovation and progress.

Figure 9: The former Bacteriological Institute. This is the front view of the Museum of Medical Sciences in the summer of 2008. Visible on the left is part of the exhibit on the 2003 SARS outbreak.

Hong Kong Scholar Ackbar Abbas has argued, writing about Hong Kong's relationship sto the 'preservation' of its colonial past, that: "The preservation of old buildings gives us history in site, but it also means keeping history in sight" (66). In a city that prides itself on its modernity, what does the preservation of the old Bacteriological Institute – and its eventual transformation into the Hong Kong Medical Museum – tell us about Hong Kong's relationship to its past and present as a 'diseased city'? The Bacteriological Institute can be viewed an example of what Abbas has termed the "Merely Local" (82), while the newly-built Centre for Health Protection (CHP), the more 'modern' equivalent of the Bacteriological Institute, is better categorized as an example of a "Placeless" facility (83). Unlike the CHP, which is a nondescript building that could literally be located in any city, the old Bacteriological Institute is an example of Hong Kong's unique history. It is particular only to Hong Kong, imbued with the city's colonial past as an important trade hub. In other words, the Bacteriological Institute can be viewed as a kind of 'placeholder' for the history of Hong Kong as a diseased city. The building's

careful preservation, then, becomes integral to the story that the Hong Kong medical and scientific communities construct about their ability to do important infectious disease research in the city.

What is interesting about these historical accounts of plague, as written by Ho and Hong Kong Museum of Medical Sciences Society and embodied in the former Bacteriological Institute itself, is that Hong Kong is highlighted not only as a site for the discovery of disease or as an 'incubator' for 'tropical' disease, but as having played an integral role in the development of present-day global public health. As 'teaching texts,' the booklet and exhibits are printed in both English and traditional Chinese. Interestingly, rather than English and Chinese being printed on opposite pages like a mirror of each other, the languages are interspersed throughout both, giving more the effect of an integration than of separation. In these narratives, Hong Kong is cast not as a passive site for research, but as a contributor "to the knowledge of the disease, its cause, its control and prevention" (Ho 2006, 36). Hong Kong is also conceptualized as both the source of and contributor to knowledge about many other infectious diseases – avian influenza and SARS being highlighted near the end of the historical account. Closing out her history of infectious disease in Hong Kong, Ho writes: "Hong Kong is therefore rightly part of the global scientific community and can be proud of the fact that it now participates in it on an equal footing with others in the best medical centers of the world's developed countries. *We can see how this has changed over the years from plague to SARS*" (2006, 73).

The author of the booklet, Faith Ho, takes pains to re-appropriate the Institute, originally British, as part of Hong Kong's heritage. Ho argues: "Let us give back a little recognition to this unsung hero, the 'Silent Protector', the place where much of the early work on health protection was carried out, and learn to appreciate and treasure this little corner of our Hong Kong heritage" (Ho 2006a: 8). The booklet itself is a commemoration of the centennial celebration of the Bacteriological Institute. Posing and answering the question of why Hong Kongers should still care about such a history, Dr. Lo Wing-Lok argues in the introduction that: "When we are almost fully consumed by the cares of the present and by the uncertainties of the future, why do we need to trouble ourselves with the past? My answer to that is our present was very much shaped by the past and our present will to a large extent determine our future" (Ho 2006a: 7).

In 2008, during one of my annual summer visits to the city, the Hong Kong University Art Museum happened to be curating an exhibition for the anniversary of the establishment of the HKU-Pasteur Research Center – internationally recognized as not only one of the premier research laboratories in the SAR, but in all of Southeast Asia. As I walked around the halls, Yersin's discovery of the plague bacillus in Hong Kong during the plague of 1894 was prominently on display. Yersin's story had become central not only to the history of medical science in Hong Kong, but to the Pasteur Institute's story of its historical collaboration with Hong Kong scientists. In both retellings of the Yersin story, continuity with the present moment takes center stage. In the example of the Pasteur Institute's museum installation, Yersin's discovery was literally placed at the 'center' of scientific research on disease agents in Hong Kong.

A straw hut, a full-size replica of the one that Yersin performed his research in, stood at the center of the Art Museum's exhibit hall. A life-size cutout of Yersin stood next to it. I interpreted the comingling of Yersin's historical discovery with the work

being done on SARS and influenza at the Pasteur Institute as a visual linkage between Hong Kong's past and present. The city's experience with the plague was placed in historical context *as part of* Hong Kong's recent experience with SARS and avian influenza. The past – quite literally – had been intimately connected to the present and future of microbiology. In the exhibit catalog, the curator made these linkages obvious, suggesting that:

> Yersin's significance in the development of public health provision in Hong Kong also makes him a fitting introduction to the science of virology, its history and its continuing importance today. In this exhibition, we hope that by understanding how Hong Kong has been affected by infectious diseases in the past, and through the work of Yersin, that visitors might better appreciate the challenges that virologist face today, such as dengue fever, avian influenza, and SARS. (University of Hong Kong, 17)

In many ways, this is a hero's tale. Yersin is depicted as a scientist, an adventurer, and a victor over his 'natural' foes – the plague bacilli. The competition between Yersin and the Japanese team is highlighted with the end result being that Yersin prevails as the first researcher to discover the bacillus. The story of his discovery of the plague bacillus is told through beautiful pictorials of his time in Southeast Asia and in Hong Kong, along with the display of various notebooks and artifacts such as old microscopes and science kits. Samples extracted from corpses, which Yersin did not technically have permission to obtain, were taken back to Paris and used to develop a serum for the plague.

Of particular interest in the exhibit catalogue is a two-page spread near the end of the brochure that shows the evolution of disease research. Foregrounded on the left page are a collection of old bottles, an old microscope, and an open book. The book is obviously very old, hand-bound in leather, and opened to a page that shows both text and a colorful illustration. The book is the visual connection between the past and the present. Directly above the text of the book, a researcher clad in a modern biosecurity suit is shown pipetting something into a small test tube. Next to him, and as opposed to the ancient, outdated microscope on the left-hand side of the page, is a modern centrifuge. This interesting pictorial montage is a prelude to the final pages of the brochure, which juxtapose the historical story of plague in Hong Kong with its effect on the modern of disease research, surveillance, and prevention. The brochure ends with the claim that:

> The 'continued presence' of plague in Hong Kong at the turn of the 20th century turned it into a place vigilant of, and responsive to, diseases and their life-threatening potential. The plague of 1894, and Alexandre Yersin's discovery of the plague bacillus that bears his name, made medical history, and located Hong Kong as an important gatekeeper in the prevention of worldwide epidemics. (The University of Hong Kong, 59)

This rhetorical stance turns Hong Kong from a diseased space into a disease source and one of the vigilant protectors of 'global' health. But here the concept of 'source' is not viewed in a relationship to stigmatization. Rather, Hong Kong's long history of being the

passive site of disease is – again – turned into a positive attribute that reflects its commitment to becoming a responsible partner in global health action. The city is thus conceptualized here as having an abundant resource, the raw material for advancing the science of infectious disease. Hong Kong's scientists and public health workers here are cast as active participants in the 'fight' against infectious disease, rhetorically transforming Hong Kongers from passive 'colonial subjects' into active and responsible 'global citizens.'

In a book written by former legislative counsel member Christine Loh about the aftermath of the SARS crisis, Loh argues that Hong Kong, the New Territories, and the Guangdong region of mainland China were collectively described by the international community as "a natural petri dish for pathogens" (7) or as "China's Petri Dish to the World" (198). She argues that international media depicted Hong Kong during SARS as a "death city" (196), with the facemask becoming a ubiquitous symbol for a diseased city (197). And yet, Loh also notes that Hong Kong's experience during SARS provided the city with an opportunity to see itself as a capable and successful scientific community. Loh argues as evidence that "half of all scientific publications related to SARS" were published by Hong Kong experts, and that Hong Kong microbiologists in particular "had received international attention" (223). The fact that two Hong Kong University (HKU) microbiologists discovered the SARS coronavirus and were subsequently held up as paragons of the international public health community only helps Loh to bolster an argument for pride in Hong Kong's scientific prowess.

Both SARS and avian influenza had positive effects on Hong Kong's international reputation as a center for scientific research on infectious disease. Hong Kong is now considered a 'flu hub' due to the quality of influenza surveillance and research in the city. It can also claim status as part of the official WHO Influenza Network and as a member of the Global Influenza Surveillance Network (GISN). To be expected, then, there are many local and international scientists working on influenza in the city, creating an atmosphere of high energy and intense competition. Some of the scientists I interviewed in 2010 believed that the scientific environment in Hong Kong produced a higher quality of work. And yet, scientists sometimes lamented that the same conditions that produced better scientific research had in turn created an equally difficult work environment. Politics intrinsic to influenza science, scientific competition, and the continual quest for international credit or precedence, were themes that arose throughout my conversations with virologists, molecular geneticists, and epidemiologists working on influenza in the city.

Lingering in the air were all the staid clichés about Hong Kong being an international petri dish for flu, or about Southeast Asia being the source for all flus, or about Hong Kong being at the epicenter of past, present and future pandemics. Professor Sam Jones, an internationally respected researcher who had been working on influenza in Hong Kong for years, told me that it only *seemed* like Hong Kong was the source of all influenza pandemics. Over coffee, he explained his reasoning to me, saying that:

> *But day-to-day, the scientifically most frustrating thing is, we publish these papers and then it always looks like everything comes from Hong Kong. The reason for that is that it's the only bloody place that's got any data. You cannot put things into the correct context. And it leads to a lot of*

> *problems for us because everybody's very keen to bash China, so it always looks like it's coming from China, and it's very convenient, you know, for certain animal husbandry industries to say, "Oh, but look, we've never found it here." But that's only true because you haven't looked.*

Another scholar in Hong Kong wondered if the more recent conceptualization of the city and region as an "influenza incubator" that had seeded every global pandemic had led to the erroneous conclusion that all pandemics would begin there.

Journalism professor Thomas Abraham told me that in his own research on the history of influenza, Hong Kong's official response to the 1997 avian influenza outbreak had often directly mentioned the 1968 flu pandemic as part of its decision-making process for culling chickens. During the beginning stages of the1968 pandemic, only one 2-year-old boy had died from infection with the virus, yet top officials from the WHO and the U.S. CDC had descended on Hong Kong anyway, worried that a deadly pandemic had already begun. Over lunch, Thomas wondered if the idea that Southeast Asia was the source for all flu might go even further back than that, to the 1957 pandemic. Maybe, he said, there was a bigger story to be told about the origins of how Hong Kong came to be seen as the world's laboratory for influenza, about how China had become conceptualized as the natural habitat of influenza viruses, and whether or not these things were merely a result of the post-WWII political atmosphere and the global antithetical attitude toward Communism.[17] Was it a coincidence that flu in Hong Kong and China became such an object of concern or anxiety during the Mao era in China, when the West – particularly the U.S. – was so terrified of Communism's spread? Thomas reminded me of the similarities of the 'war on flu' with the 'war on terror' – both fighting invisible agents that might attack at any moment. But public health has always relied on a war metaphor, so it didn't necessarily strike me as odd that when the type of war being waged shifts, so would the metaphor.

Talking with another researcher – an epidemiologist – about the historical phenomenon of influenza in Hong Kong, I brought up the notion of flu fatigue. He laughed and corrected me:

> *Infectious disease fatigue! They've been there, done that, they got the t-shirt in 2003. And flu is of, like, no concern to them. People in HK are very hygienic. I'm sure you know full-well. . . . HK is seen by the rest of the world as a place where people where masks all the time. From SARS.*

[17] This, I know, is a 'loaded' statement. Unfortunately, there is not enough space here for an in-depth discussion of the possible ramifications of viewing microbes through the lens of Communism, terrorism, and the concept of contagion. For further reading on the use of war metaphors in immunology, see Emily Martin's book, *Flexible Bodies*. For further reading on the concept of contagion, refer to Mary Douglas's *Purity and Danger*. For an thoughtful account of microbes and politics throughout the Cold War, and how the language of viruses invokes that of communism, see Priscilla Wald's *Contagious: Cultures, Carriers, and the Outbreak Narrative*. While I have no doubt that the handover of Hong Kong to China in 1997 from British rule affected the 'Western' reactions to the Chinese authorities handling of the 1997 bird flu outbreak , I cannot do more than hint at the relationship between international politics and public health here. I leave it in the text, however, to indicate that global politics play into how Hong Kong residents and scholars make sense of both historical and more recent events in public health.

But they don't. If they're sick, they will. But in the general population, people who aren't sick, there's a very low rate of people wearing masks.

Hong Kong's plague, cholera, TB, malaria, dengue, SARS, and avian influenza past is present in the embodied exhaustion that Hong Kong residents – including its scientists, public health workers, and infectious disease experts – sometimes express in relationship to the city's reputation for being a site for outbreaks of infectious disease. It is a complex interplay between being 'accustomed' to disease outbreaks and being 'fatigued' – or almost bored – by them. Hong Kongers often voiced this feeling by suggesting that flu is only a big deal for people who haven't lived through SARS. This is the Hong Kong 'attitude' to flu, prevalent in almost every conversation I had with citizens unconnected to the science of influenza or the business of disease prevention. And even some of the health professionals have a complicated relationship to their proximity to disease, to the city's international reputation as both a source of pandemics and as a 'highly capable' health system. A top health official explained it to me in this way:

First I'll start by saying that in some ways Hong Kong is lucky to have the experience of the avian flu – H5 – in 1997, and of course, SARS in 2003. Those were the wake-up calls and we identified a couple of weaknesses in the system, and we spent a lot of effort to improve certain things. You know, we didn't actually have the Centre for Health Protection before 2003. . . . We had made up a contingency plan, and then we conducted a couple of drills, both internally and with outsiders – including China and our neighbors, Guangdong province, and so on. So we made sure that everyone is prepared to do what they are supposed to do when a 'next pandemic' comes. And sure it came, but it came at a surprising place. We had always thought that it would come from somewhere in China.

Hong Kong here is both 'lucky' to have had experience with pandemics and 'unlucky' in that it has China for a neighbor. One of the reasons regularly cited in support of Hong Kong being such a good site for conducting research on infectious disease – especially influenza – is this proximity to its 'source.' It is Hong Kong's complex identity as a Westernized Chinese city that I would like to explore in the next section, particularly in relationship to how scientists who work in the city position themselves and their research at the local, national, and international levels.

'Chineseness' in the 21st Century: Identity, Politics, and the Positioning of Science in Hong Kong

Hong Kong is China. That was, is and remains the abiding cornerstone of survival for the unique territory. – Richard Hughes, 1968

The debates about the future direction of Hong Kong will continue to be intense as the meaning of its boundary is being reshaped by the changing social and economic ties with the Mainland, on the one hand, and the

> *increasingly uncertain global environment on the other.* – Carola McGiffert and James T.H. Tang, 2008

Is Hong Kong Chinese? Or is it global? In what follows, I will examine how the question of Hong Kong's identity and position within larger global scientific, economic, and security networks not only bleeds into scientific debates over the origins of influenza pandemics but how scientists and public health officials in Hong Kong position themselves as experts in the field of global health. The fluidity of Hong Kong's floating identity is central to grasping the SAR's rationale for quarantine during the 2009 H1N1 pandemic as well as for understanding how the city is transforming itself from an international incubator for disease into an globally-recognized laboratory for research on readily-available disease agents. I argue here that influenza science is already imbricated in a growing web of connections that bind Hong Kong both to the Mainland and to the 'West' (in this example, the 'West' is typified by the United States and the United Kingdom). As such, the question of Hong Kong's identity is a central political and economic question for those both inside *and* outside of the SAR.

In an edited volume on Hong Kong published by the U.S. Center for Strategic & International Studies (CSIS) on the 10-year anniversary of the territory's reversion to China, security expert Derek Mitchell opined that:

> Hong Kong's geography places the territory at the epicenter of many potentially devastating challenges to international security, in health, the environment, and financial security. As a major international transit point for goods, services, and people throughout Asia, it is to Hong Kong where these challenges can spread quickly, and from Hong Kong where these challenges can spread rapidly throughout the world. (122)

In the same volume, anthropologist Helen Siu argued that Hong Kong's culture has always reflected "a consciously hybrid, bricolage quality" (199), making even the modern concept of the 'Hong Konger' an "elusive term, because it does not define a static target population" (195). Rather, Siu argues that Hong Kong is – and in many ways, has always been – "a space of flow" (203) where the circulation and exchange of goods, people, and ideas is paramount to its 'flexibility' and its linkages to the rest of the world (204). In both accounts above, Hong Kong is not simply conceptualized as a 'Rosetta stone' for the translation and exchange of ideas, values, and technology between 'East' and 'West,' but as an "obligatory point of passage" (Latour 1987) in myriad global networks. In this way, the whole of Hong Kong can be viewed as a modern-day 'laboratory' not only for the mixing of microbes, but of politics, economics, and 'cultures' of various kinds. But what kind of 'identity' is being produced in the liminal place of 'in-betweenness' that is Hong Kong? And, perhaps more importantly, why is the very question of Hong Kong's identity cause for such local and international angst?

To begin exploring the seemingly ubiquitous 'problem' of identity in Hong Kong, I borrow first from the work of anthropologist Xin Liu on the experience of the 'self' in Southern China. Like Liu, and as a former long-term resident of the SAR, I am less interested in writing about my *observation* of identity politics in the city than in my "ethnographic understanding" (Liu, xi) of what it means to be a 'Hong Konger' and how

local uses and constructions of identity impact the practice of science and public health within the territory. In an article critically unpacking the concept of 'Chineseness' itself, China scholar Allen Chun has argued that "identity is essentially a tie that binds people to communities through webs of power and meaning" (125). Like Chun, then, I am interested here in: 1.) how identity in Hong Kong – formulated as either 'Chinese,' 'Western,' 'Asian,' or 'global' – is navigated by the scientists and epidemiologists who work under the rubric of global public health; and 2.) how Hong Kong's floating identity might trouble already-established 'webs of power' and the production of 'universal meaning' in epidemiological science. Borrowing directly from Chun, I argue that identity in Hong Kong "is essentially a pragmatic, or subjective, relationship" and is "*selective* and *strategic* by nature" (126). If all Hong Kongers must selectively position themselves vis-à-vis the Mainland and the U.S. and U.K., then I want to explore "what all these positionings really *mean*" (Chun 129) and begin to ask "when and why identity is being invoked" (Chun 132) by the public health professionals and scientists I interviewed during the 2009 H1N1 pandemic. Before I analyze the accounts of the scientists and officials themselves, however, I must first attempt to sketch out what it is like to be a Hong Konger in the 21st century via an all-too cursorily exploration the city's most recent 'identity crisis.'

Anxiety over the Hong Kong's 'identity' was no less prominent when I visited the city during the spring of 2010 – in the midst of the so-called 'second wave' of the 2009 pandemic – than it had been throughout the years I had lived and studied in the city (2003-2006). In an editorial published in the South China Morning Post (SCMP), Alex Fong, the chief executive of the Hong Kong General Chamber of Congress, lamented how commentators always seem to want to argue that "Hong Kong is suffering from an identity crisis" (2010). Was Hong Kong an international or Chinese city? Why the necessity to keep operating under these old questions, Fong asked the SCMP readers. Instead, Fong suggested that Hong Kongers embrace the fact that Hong Kong is and always has been both. In fact, it is Hong Kong's "dual characteristics" that had always been its real strength as a finance, trading and business center (Fong 2010). Another editorial, written by a woman in her twenties, tried to explain why her generation – the 'post-1980s generation' – was so disillusioned. She lamented that Hong Kong's position in the world was no longer unique, that the rise of the Chinese mainland had left Hong Kong's youth in a bad position, and that the Asian financial crisis and SARS had left Hong Kong decimated. In effect, she argued that the city was still coping with the effects of both. The author then suggested that Hong Kong had gone from a position of "uniqueness" to one of increasing "uncertainty" – literally arguing that while Hong Kong was once considered to be "the land of opportunities," it was now "the land of uncertainties" (Wong 2010). These editorials reflect two sides of an already well-trod argument – a cyclical debate over 'identity' that I became intimately familiar with as a Hong Kong resident. Apprehension over Hong Kong's position – geographically, culturally, and in relationship to global finance and trade networks – was frequently palpable in everyday conversations. Most of the worry centered on a single set of questions: Was Hong Kong Chinese or Western? After Hong Kong fully integrated with China, would it lose its status as an international city? Would it – could it – maintain its 'unique' position in the world?

In April 2010, the Hong Kong SAR and Guangdong Province signed a historic agreement to cooperate bilaterally on future policy affecting the Pearl Delta River region. For the first time, the two regions are structured to work cooperatively, rather than competitively or separately, on issues of finance, trade, health, and the environment. Beijing officially supported the agreement, and party officials announced their hope that cross-border coordination would mean that the Pearl Delta Region would be better able to keep up with other metropolises, such as Shanghai. Hong Kong is scheduled to become a part of the China – *in toto* – in 2047, when it will lose its SAR status.[18] This type of cross-border agreement is a forebear, in a sense, of things to come. It is also a symbolic attempt to ease this future transition, if you will, an opportunity for both sides to carefully learn how to 'speak' and to 'hear' one another's language. Paradoxically, such cross-border agreements, increased transparency, and better communication between Hong Kong and the Mainland only serve to exacerbate Hong Kong's so-called identity crisis.

After the 1997 handover, residents and scholars of the SAR began to collectively hand-wring over Hong Kong's establishment as a unique culture in and of itself. The sentiment still lingers today. Worries related to the eventual end of the official 'one country, two systems' policy are not localized to Hong Kong. In the 2008 CSIS volume entitled *Hong Kong On the Move* (a collection of essays exploring the 'future' of the SAR), a variety of Hong Kong and China experts express a collective trepidation about the viability of Hong Kong's political system; a system currently conceptualized as a 'partial democracy' that exists as part of a larger socialist and autocratic system – a political 'hybrid,' if you will. Any change in Hong Kong's political status, the logic goes, would negatively affect global trade, the regional economy, and global security. The central question, then as now, is captured by the editors in their introduction. They suggest that:

> From the outside, Hong Kong's reversion [in 1997] was either an ominous triumph for a rising Beijing, hence the notion of 'the death of Hong Kong,' or a reJamesable opportunity for Hong Kong to move China toward greater openness – 'who would change whom?' was a question widely debated. That question remains central to the discussion about the Hong Kong of today and of tomorrow. (McGiffert and Tang, xvii)

Undergirding any optimism about the future throughout *Hong Kong on the Move* is Hong Kong's professed 'uniqueness.' Many authors in the volume edited by McGiffert and Tang use similar or identical language to describe and explain Hong Kong's unique advantage in an increasingly 'global' world. Hong Kong is variously depicted as: "an economic center" (xxi); a "coordinator" in terms of supply chains and trade (76); a "trade conduit" (81); "the natural gateway for China" (82); a "testing ground" for policy (85); "a bridge between the Mainland and the rest of the world" (86); "a unique city in the world"

[18] According to the terms of the joint Sino-British agreement, Hong Kong will become fully-integrated as part of the Chinese state in the year 2047 (50 years after the British handover of sovereignty). This date conjures much trepidation both inside and outside of the SAR, since Hong Kong's 'special status' – along with the protections for its rule of law, freedom of the press, and autonomous government – will end as the territory becomes part of China.

where a capitalist system comfortably co-exists as part of a socialist country (90); a city of "dynamism" and "flexibility" (90); a "model of success" for security (110); "a lynchpin of economic security and growth" (111); "a leader" (118); as possessing a high level of "adaptability" (121); "a model for all nations" (122); a "free Jameset" (137); capable of "considerable flexibility" (144); as possessing a people full of "spirit, energy, and resilience" (156); a committed "player in global public health" (157); as "playing an important leadership role (158); as "walking a fine line" between "domestic and international scrutiny" (182); and finally, in sum, as "a dynamic center of international business, an English-speaking bridge to the Mainland, a welcomed port of call for both civilian and military seagoing craft, and a sophisticated financial services center" (190). Note the repeated stress on Hong Kong here as a liminal space that is unique in its capacity to be *flexible, to adapt to changing circumstances, to "move" with the political and economic tides*. It is sometimes said in Hong Kong that the early use of the phrase "the floating city" to describe the territory had a dual connotation: the first meaning was literal, or a direct reference to the many 'boat people' and 'boat houses' that populated the city; the second was figurative, or an illusion to the idea that the 'identity' of Hong Kong citizens – particularly its Chinese denizens – 'floated' in and out on the political tides. One day the 'Chinese' were Chinese, the next day they were British. 'They' or 'we' (depending on the self-identification of the speaker) changed political and cultural 'allegiance' as it suited them (or us). From the very beginning then, Hong Kong's identity was conceptualized as 'floating' in nature, or reflecting the pragmatic or practical 'adaptability' of its people.

While "locals and expatriates alike used to take refuge behind the ideological image of Hong Kong as a 'cultural desert'" (Abbas 25), or a culture of no culture, the threat posed by the 1997 handover of Hong Kong to mainland China created not only an intense examination of Hong Kong's historical and present-day identity, but an immediate need to locate a unique local culture residing within the SAR to bolster against the impending rule of the Mainland. Hong Kong scholar Abbas suggested that this would remain difficult to do, since Hong Kong's only history was that of colonialism (2). In other words, and unlike other postcolonial sites such as Africa or India, Hong Kong has no 'pre-colonial history' to set against its experience as a colony in order to carve out a distinct culture.[19] This makes it, however, and in an ironic twist, a unique culture. Commonplace binaries traditionally used to describe Hong Kong – East/West, modern/traditional, or local/global – are not appropriate and inadequate to the task of examining Hong Kong's identity (Abbas 11). And yet academics, including anthropologists, remain prone to using the clichéd notions of "an ideal West and an ideal East" (Evans and Tam, 10) to analyze Hong Kong. Such binarisms cannot elucidate Hong Kong's interstitial position, but simply serve to further confuse the issue of Hong Kong's identity. Hong Kong's resultant 'existential crisis' bleeds into all aspects of life in the city. For Abbas, the continual threat of cultural disappearance has caused what he terms a feeling of "déjà disparu" in the city: "the feeling that what is new and unique about the situation is always already gone, and we are left holding a handful of clichés, or cluster of memories of what has never been" (25).

[19] The argument that Hong Kong has no 'pre-colonial' history is based on the idea that before the Chinese ceded Hong Kong Island to the British, the rocky island had only a few 'residents.' Most of Hong Kong's residents are thus 'immigrants' to the territory, not 'natives' to the region.

That the conception of Hong Kong as a 'bridge' between or as a 'mixture' of East and West is clichéd, however, does not preclude Hong Kong natives and expatriates alike from using it to describe the city (Lo, 9). Scholar Kwai-Cheung Lo has provocatively argued that Hong Kong is not unique at all; rather that its inimitability subsists in its characteristics as an "elusive, hybrid, slippery and inconsistent" place (6). From this perspective, Hong Kong continues to be a port, but in a different delineation of the term. Abbas, echoing Lo's description of Hong Kong's character, takes the concept 'port' quite literally, suggesting that Hong Kong is: "a door, a threshold, a conduit through which goods, currencies, and information flow; a kind of nodal point, an in between state, therefore more of an inter-national city that an international one" (74).

Anthropologist Tim Choy has also argued against using too-easy binarisms and concepts such as universality or particularity to describe Hong Kong, looking instead at "how particularity comes to work as a James of expertise" (2005). Knowledge produced in a place like Hong Kong must be simultaneously universal and particular for it to be effective. Thus, what becomes important about the production of knowledge in Hong Kong is its form. Choy examines the development of environmentalism in Hong Kong, to analyze how the process of translating Western or 'global' terminology and concepts into 'local' Cantonese ultimately re-instantiates a gap, and reconstructs cultural differences, between East and West (12). Choy's work recalls Abbas's critique of binarisms, where locating the shifting differences between East and West "becomes a kind of parlor game" (117).

It should be no wonder, then, that scientists and epidemiologists working on influenza science in Hong Kong struggle to articulate Hong Kong's position in global public health networks. Both 'Western' and 'Hong Kong' scientists were hyper-aware of their roles as both 'local' and 'international' scientists. In discussions about their work, Hong Kong researchers regularly "code-switched" (Evans and Tam, 5), or talked about themselves and the scientific product of their research as up to 'international' standards on one hand, and as representative of a 'local' situation on the other. One researcher even lamented to me that: "Unfortunately, Hong Kong is more British than the British. You know, the colonial roots . . . you just cannot unplug." The scientists that I spoke with described their research on influenza as relevant and important to the international scientific community-at-large, but also particular to the situation in Hong Kong. They located both themselves and their research in larger professional and personal networks, and in interviews, scientists and epidemiologists alike regularly discussed the developing relationship to their Chinese counterparts in Guangdong or Beijing, always noting how much better the situation was in 2010 than it had been in 2003, during SARS.

Alexis Lau has noted that during the SARS crisis "few people took the reports from across the border seriously, because of a lack of trust either in China's capacity and disease control and prevention or in the accuracy of data" (86). In point of fact, SARS was a watershed moment for cross-border cooperation. As one policy expert noted: "SARS revealed weaknesses in the 'one country, two systems' framework that are now leading to changes in the relationship between Hong Kong and its immediate hinterlands in the Pearl River Delta and Guangdong Province" (DeGolyer 137). Ironically, a virus had helped to conceptually link or integrate Hong Kong back into the Mainland. An acute outbreak of infectious disease had done what years of economic cooperation had failed to do – it forced Hong Kong to directly confront its past, present, and future relationship to

mainland China. Christine Loh has argued that one effect of SARS is that: "Hong Kong now sees itself more clearly as part of the neighborhood of Guangdong Province. Furthermore, it has also become more evident that Hong Kong is an integral part of China, although it functions as a Special Administrative Region (SAR)" (140). The outbreak of the SARS virus was one of the first impetuses for what would become a series of pioneering cross-border agreements, with both Hong Kong and Guangdong agreeing to share information on outbreaks more freely and to continue to foster better cooperation (Loh 157). As a former Legislative Council member, Loh links this agreement, itself a result of the SARS crisis, to China's "drive for modernization" (160). She also sees continued integration as part of an "opportunity to create the model for new China" (160). Here Hong Kong is regarded as not only a part of China, but as integral to China's development and modernization in the 21st century.

If throughout China's more recent history, Hong Kong had become a proxy for China (Evans and Tam 1997, Hughes 1968, Lo 2005), then Loh's comments above highlight how the city is now being shaped as a new representation of today's China. This reassertion of Hong Kong's position as a Chinese city is important to the construction of what it means to be 'Chinese' in a global world. Kwai-Cheung Lo, who also self-identifies as a Hong Kong 'native,' has argued that Hong Kong is a "crack in the edifice of Chineseness," and simultaneously "exaggerates and negates Chineseness" (4). For Lo, the effects of Hong Kong's past are very much 'present.' He suggests that:

> To many foreign visitors, Hong Kong already appears to be a very 'Chinese' city. It was used to exhibit Chineseness when the 'real' China could not be accessed. In fact, the returned Hong Kong may serve as an exemplar of Chineseness not because the colonial city disassociated from Chinese culture in order to produce a Hong Kong identity, but because it has been producing and reshaping Chineseness since the early colonial era. For decades, Hong Kong's popular culture has succeeded in creating and perpetuating an abstract kind of Chinese nationalism and identity for a global audience. (Lo 3)

For Lo and other scholars, then, Hong Kong's culture is an example of what Abbas has termed a "postculture," defined as "a culture that has developed in a situation where the available models of culture no longer work" (145). In this framework, culture itself is experienced as a series of instabilities (Abbas 145). Binaries and boundaries break down; there is no such thing as a stable category in Hong Kong. No such thing as a Chinese or a Western scientist, or Chinese or Western science, or Chinese or Western public health. There is only the work currently being conducted in Hong Kong. There is only the Hong Kong response to the H1N1 pandemic. Everything is always being described or explained on multiple registers. The city and its scientific community is phenomenologically experienced as a ground that constantly shifts under one's feet and is forever changing, morphing, growing, or being torn down.

A concrete example of the inherent difficulty and slipperiness of Hong Kong's global position vis-à-vis public health was the promotion and election of Margaret Chan, a Hong Kong 'native,' as the first 'Chinese' director general of the WHO. As Simon Shen has argued, Chan was "constructed as a 'Chinese Hong Konger,' rather than an

ordinary Chinese person" (362) by both the Hong Kong and Chinese media throughout her campaign for the position. Her role in Hong Kong during the SARS crisis was a key factor in her election. Shen argues that the election of Chan Jamesed a turning point in China-Hong Kong relations, as the first instance of a native Hong Konger being elected to represent the Mainland on at a high level of international diplomacy (364). The reason that Chan was an especially attractive candidate to Mainland Chinese officials, Shen argues, was her identity as a Hong Konger. Chan was trained in Western methods, but Chinese in citizenship and in terms of her 'culture.' This type of 'in-between-ness' produced by her status as a Hong Kong citizen ironically made her the perfect 'Chinese' representative for election to an international regulatory body. In essence, then, Chan – like Hong Kong itself – spanned the East/West divide and represented a new 'Chineseness' on the world stage. Shen argues that the mainland's decision to promote Chan as a candidate signaled a deft policy move and was symbolic of the developing relationship between Hong Kong and the Mainland. As a leftover of the colonial era, Hong Kong's character as an 'international city' was transformed into a diplomatic tool.

Still, despite evidence of the development of an increasingly 'close' relationship between China and the SAR, scientists in Hong Kong often expressed a lingering mistrust of their counterparts across the border – a leftover, if you will, from the region's experience with SARS. At issue was not just personal trust, but professional capacities. They were also self-reflexive about the cultural and overt politics – and competition – associated with doing influenza research in the SAR. As one scientist expressed it to me, infectious diseases were "inevitably political." After I had explained the object of my fieldwork as an anthropologist, he mused that:

> *Hong Kong would be a fascinating place to study. When it comes to the virus research and stuff like that, because you have quite a high number of people publishing in very similar areas, and you don't get that in other areas. And there's a huge amount of internal competition, which I think, in a way, almost contributes to the quality of the science coming out. You're not just worried about being trumped internationally; you're worried about being trumped locally.*

It is the inherent tension conveyed above, itself caused by a combination of factors related to Hong Kong's interstitial position – as a hybridity of a Chinese city, an international or global city, a diseased city, and a city with abundant influenza resources – that I will examine in the next section. Hong Kong's 'floating identity' – as both Chinese and Western, neither British nor Chinese – plays a crucial role in how scientists and epidemiologists who work on influenza in the SAR position themselves and their research within larger global networks. The 'flexibility' and 'adaptability' of experts working in Hong Kong is, in part, what allows them to craft and enact 'unique' public health policies that, in turn, have 'ripple effects' within the global health network. Nowhere was this more visible than in the decision of Hong Kong authorities to utilize containment methods during the first wave of the 2009 H1N1 pandemic. The resultant international debate over the 'effectiveness' or 'correctness' of quarantine and school closures in Hong Kong highlights the cultural politics at play in the contextual

interpretation of scientific data in an effort to produce 'best practices' for public health response.

An Ethnographic Understanding of Floating Identity, Epidemiological Translation, and Debates over the 'Effectiveness' of Quarantine in Hong Kong

> *They were doing temperature checks at the airport. A woman with a face mask at the top of the escalators heading into the immigration area was scanning foreheads. I felt a bit nervous as I passed her. I had been joking for weeks about ending up in quarantine, about what a hoot it would be to have that experience as part of my ethnography on the flu outbreak, but it was dramatically less humorous when I found myself actually faced with the prospect. I had seen signs up everywhere about de-sanitization taking place every hour, on elevator buttons, on entry-way rugs. In the airport, they were broadcasting messages warning people not to socialize if they had a fever, to stay inside instead, and to make an appointment to see a doctor. The announcements were looped continuously in English, Mandarin, and Cantonese.*
>
> *For the first few days, I ventured out in the afternoons, along with throngs of other people milling about the city. As I walked around the streets of Hong Kong and Kowloon, I found myself wondering if there had always been this many people in Hong Kong. I must have become accustomed to the level of population concentration over the years that I had lived here. Now, I am a foreigner all over again. I often find myself perplexed and overwhelmed by the sheer density of bodies everywhere.*
>
> *No wonder Hong Kong officials decided to quarantine. It must feel like an epidemic is inevitable. You can almost visualize with the naked eye exactly how a virus might pass from person to person. So many transmission points, so many methods. Hong Kong: an epidemiologist's nightmare.*
>
> -- Notes from March 6, 2010

Throughout my fieldwork, it often seemed to me that no group was more surprised – or almost impishly delighted – that the 2009 H1N1 influenza virus had not sprung out of the SAR or Guangdong Province than the collection of flu experts working in Hong Kong. The region was familiar enough with being the 'incubator' or epicenter of infectious disease outbreaks – such as SARS or avian influenza – but had little recent experience with being on the furthest periphery of them. Most national pandemic plans used an 'old' model and thus were primed to defend against the importation of disease – not its export. Hong Kong, on the other hand, was fully prepared to play both defense and offense against the virus. As a 'space of flow' for finance, goods, and people, Hong Kong views itself as an importer/exporter of everything – including disease. Epidemiologists and microbiologists there know better than anyone else that in a globalized world,

infectious diseases travel through the nodes of a network; they don't usually linger around just one of them for long. So when public health officials and scientists working on flu heard about the late seasonal H1N1 outbreak in Mexico in March/April 2009, they knew for certain that it would travel. The question became, then, not 'if' Hong Kong should get ready for an outbreak, but 'how long' the city had to activate its various response systems – including various containment and mitigation measures such as border screening, quarantine, and school closures.

By the official close of the pandemic, however, it would be Hong Kong's – and China's – decisions to quarantine and close schools during the earliest days and weeks of the outbreak that would remain part of the touchy international debate over the effectiveness of the H1N1 response. Universally viewed as having a highly-functioning and respected public health system, Hong Kong's official decisions to quarantine and to temporarily suspend classes in the territory caused the most external confusion, especially as seen from the 'Western' perspective. U.S. public health professionals, in particular, saw quarantine as a worthless measure during an influenza outbreak. Notoriously difficult to contain, influenza was best dealt with through mitigation efforts like social distancing, hand washing, and prophylaxis (such as the use of Tamiflu in patients). This had been the reigning paradigm in the U.S. for responding to the 2009 H1N1 pandemic. But in Hong Kong, the thinking had been slightly different. As people there repeatedly explained to me, Hong Kong was unique in that it was a small and densely populated area. It had the resources and systems in place to quarantine. It had a unique social system that was more prepared to deal with the effects of short and long-term school closures. What's more, I was told, the populace expected quarantine, almost demanded it. In sum, containment measures like quarantine and school closures worked for Hong Kong when they wouldn't have worked anywhere else.

I became intrigued by the ways in which Hong Kong public health officials talked about and defended their early response; above all their decision to implement quarantine after the first case was discovered there in May of 2009. The decision to quarantine – in particular – was representative of Hong Kong's interstitial position between two worlds, two public health response paradigms, and two ways of thinking about the same issues. But I suggest here that it is *also* representative of Hong Kong's successful deployment of its 'floating identity' to bolster itself as an influenza resource *and* as a responsible and important partner in the global health network. In effect, and to play upon the narrative of Hong Kong as 'the floating city,' Hong Kong's scientists and epidemiologists are 'Chinese,' 'Western,' and 'global' as it pragmatically suits them. Quarantine, then, is largely symbolic of larger cultural and political issues.

This is not to suggest, of course, that quarantine itself has even been conceptualized as an entirely 'neutral' act. As historian Sheldon Watts' work has shown, even during the height of the plague years in Europe, quarantine was often met with hostility. The general populace, though frightened by a severe outbreak for the first week, quickly "grew accustomed to its depredations and, when left alone, attempted to go about their ordinary affairs" (Watts, 18). Quarantine, then as now, disrupts 'normal' trade and the routine traffic of goods and people; outbreaks of 'plague' have always occasioned an official intrusion into the daily practices of an entire populace and has thus often been viewed as an aggressive or excessively authoritative act. As Watts depicts again and again throughout his book on the political and social effects of infectious disease through

the centuries, outbreaks were indeed *perfect opportunities* for the ruling authorities or governments to intervene in the daily affairs of the public, creating what Watts calls an "Ideology of Order" (16). David Arnold suggests, in his examination of disease and colonialism in India, that Western medicine was always more than just a 'tool of empire.' Medicine, at least as it pertained to infectious disease and public health, had to "grapple with an abiding contradiction between universalizing and Orientalizing" (292). As we saw in the first section of this chapter, Hongkong fever was a localized, but universal, affliction. It occurred in a specific place – thus giving the 'fever' its unofficial nomenclature – but was a generalized threat to 'public' health. An authority could justify quarantine in a locality, then, by using recourse to the language of protecting 'universal' health.

From this historical vantage point, then, one might have predicted that Hong Kong's recent decision to quarantine during the 2009 influenza pandemic would be met with the same international approval as its past decision to quarantine during the outbreak of SARS in 2003. Instead, the decision was derided as an 'overreaction.' It was largely seen as being based, as I often heard from those working in public health outside the SAR, on 'questionable' or little hard scientific data. As such, I was repeatedly assured 'off the record' that Hong Kong's decision to quarantine was simply political. Hong Kong quarantined because it could, because China did and it was a 'Chinese' city, and because it had a different 'culture.' I often found myself puzzling about the problem of quarantine, as it was couched by non-Hong Kongers, as a 'Chinese' reaction to outbreaks of infectious disease. How and why had a brief quarantine in Hong Kong (the confinement of airline passengers that began in early May 2010 lasted approximately a week) become part of a larger international debate over the 'effectiveness' of quarantine?

One provocative explanation is that events in Hong Kong are never 'just' about Hong Kong. Hong Kong scholar Kwai-Cheung Lo has argued, albeit from a slightly different context than infectious disease, that: "The Hong Kong issue, when put in the context of international politics, is never confined to a local or national problem but is conceived in terms of a 'global design' for the remaking of the power hierarchy in the world" (13). Elsewhere, I have detailed how the practice of science in China is conceptualized as a 'problem' and how the influenza virus – prior to the 2009 pandemic – had become almost entirely associated, or nationalized, as a 'Chinese problem' (MacPhail 2009, MacPhail 2009a). Here, however, and echoing Kwai-Cheung Lo, I want to suggest that the debates over quarantine in Hong Kong during 2009-2010 are archetypal of cultural politicking. Hong Kong has come to stand in for both 'Western' science and 'Chinese' application and thus has become 'problematic' to both sides of the East/West equation. Throughout what follows, I focus upon interviews conducted in April 2010 with two of the top-ranking epidemiologists in Hong Kong. Both, like Margaret Chan before them, are 'native' to Hong Kong and obtained extensive 'Western' training in their field, (typically in either the U.K. or the U.S., but occasionally in Australia). Both also had vast experience collaborating with their counterparts on the Mainland. As such, they were positioned as natural 'translators' of epidemiological science, adept at packaging Western techniques and ideas for application both in the SAR and in Guangdong Province. Literally and metaphorically, then, they were seen as being able to 'speak' multiple languages, often all at once.

Their personal and official retelling of events below is an attempt not only to explain or to justify official actions, but also an attempt to create a political and ideological space for Hong Kong's unique position as both Chinese and Western in global scientific and health networks. Their decisions and actions during the pandemic were often self-consciously located *in-between* different systems, and the region's interstitial position qua China, the United States, Asia, and Europe was often pointed out to me as a particular strength of Hong Kong's public health system. The decision to quarantine in 2009 was also explained in relationship to Hong Kong's experiential past with SARS in 2003 (and, to a lesser extent, with H5N1 in 1997). What follows is moreover my *ethnographic understanding* of how individuals articulated their positions in larger networks through the deployment of both their own and Hong Kong's floating identities *in historical time and in geographical and imagined space*. Therefore, I attempt to (re)create 'a space of flow' here in which these highly-regarded professionals speak for themselves. Below are their private accounts, which together may be read as an 'official' narrative, of the discovery of the first case of H1N1 in Hong Kong and the actions that followed it. Both men navigated 'identity' and the question of expertise through their own understandings of Hong Kong in relationship to China, to Asia, to the larger 'global community,' and to prior disease outbreaks. The fluidity of their identity – as 'local' Hong Kong epidemiologists, survivors of SARS, 'global' public health professionals, and as influenza experts – undergirds the adaptability and flexibility of their responses throughout the 2009 H1N1 pandemic.

***

My first 'official' interview took place in the heart of Kowloon. Inside, the halls of the modern building were eerily quiet. I was ushered into a large meeting room and given hot tea while I waited for Dr. Ken Wang.

After he shook my hand and joked with me about the people we knew in common, I immediately relaxed. He asked if I already knew about his experience working at the California State Health Department as part of the highly selective U.S. CDC's Epidemic Intelligence Service (EIS) training program. This information was proffered at the commencement of introductions and 'small talk'; we then immediately swapped 'war stories' about the 2009 pandemic in part to 'locate' each other in the expansive public health network and to build trust. Not for the first time, I was made aware that my connections made it far easier for me to gain entrée to public health experts in Hong Kong. I told Dr. Wang that I identified as a 'Hong Konger' and about my time living in the city and he smiled and nodded. I had already realized that being a former resident was not infrequently an aid to my research. Like Dr. Wang, my floating identity often emerged in these quasi-official, yet strangely intimate, moments of sharing experiences and information. Dr. Wang and I deployed our identities as a former Californian and a former Hong Konger in order to formulate a stronger informal bond, to locate ourselves within larger circles or networks, to show our association with different 'tribes' of experts, scholars, peoples. In essence, then, we were attempting to establish an 'understanding' that we would rely upon throughout the conversation that followed.

Ken Wang:

> *The first case came on May 1. You probably heard that this patient came from Mexico and he went into a hotel, and then finally went into a hospital where he was diagnosed with H1N1. So, at that juncture we did two things. First, we declared that Hong Kong would upgrade our emergency preparedness level to the highest level. And the second thing we did on that day was to quarantine the hotel. It was not an easy decision, actually, because you're talking about quarantining 300-plus people for a seven-day period. But we thought that we had to do this. Because it was the first case in Hong Kong and we were very worried that this would be a highly lethal infection. And with the experience of SARS, particularly, since SARS actually happened in a hotel in the first place in Hong Kong, we thought that history was repeating itself. So, at the end of the day, after the seven-day quarantine period, there were no new cases, and then we let go the travelers who stayed in the hotel. And actually, they came out pretty happy about it. So that was a difficult decision. Because I think from the eyes of the American people, they would have thought that this would be a drastic action, right? Oh, this is just flu. Why all the fuss about quarantining a whole hotel, 300 people for seven days? But I think Hong Kong, because we went through SARS – it was a very painful experience. OK? So both from a public health angle and from a political angle, I think, by and large, the local people supported this action.*

From this, two lines of reasoning begin to emerge. First, the choice to quarantine – as a decision that was framed as being particularly difficult to make – is predicated on a relationship to the past. Hong Kong's recent experience with SARS, then, is quite literally present during the 2009 outbreak of H1N1, and forms part of the logic or rationale for quarantine. Second, the justification for quarantine in Hong Kong is self-reflexively located in opposition to the United States' decision not to attempt to contain the virus. Hong Kong's action is partially conceptualized through the 'gaze' of other experts – in this case, the United States. As a former resident of Hong Kong *and* a representative of the 'American people' Dr. Wang references above, I am implicated in the 'we' in my understanding of Hong Kong's situation, but also an 'other' in my capacity as a temporary employee of a different national health agency. For his part, Dr. Wang is cognizant here of being representative of both Hong Kong's point of view and an epidemiological authority. The self-awareness that he displayed above in relationship to how quarantine was viewed from both inside and outside of Hong Kong is reflective of Dr. Wang's floating identity as both an 'international' scientist and a Hong Kong citizen.

Dr. Wang immediately continued, and without interruption from me, to discuss events after quarantine.

> *Now, another turning point came on June 10, exactly 40 days after the first case. On that day, an event happened; there was a secondary school outbreak of H1N1. And they did not have any travel history. In other words, we experienced the first local outbreak. So when we have our first*

> *local outbreak, we have to change our strategy. Because containment will no longer work! It is already spreading in the community. So, gradually we migrated into the so-called 'mitigation phase.' By mitigation we mean we're no longer locking up people in hospital, or doing quarantine measures, but instead we will focus on the serious cases. Make sure they get treated. Get the medical system prepared for a large number of patients with H1N1. And also prepare for the vaccination program. So, there was a change in the way we handled the whole outbreak. . . . If you asked me on which information our decisions were based, I would say the country reports, the WHO's advice, and – of course – our local picture, in Hong Kong.*

This discussion highlights Hong Kong's 'unique' experience during the first wave of the H1N1 pandemic by first grounding its decision-making in solid epidemiological reasoning, or, in other words, in a scientific logos that can be internationally agreed-upon. Here, Hong Kong's judgments are based on a local analysis of international events and upon information that was circulating during April, May, and June of 2009. For my part, I want to stress the use of the 'local picture' here as it relates to the 'translation' of international information as circulated by the WHO. Hong Kong officials, much like their counterparts in the U.S. or the U.K., must take local context into account in order to make any sense out of globally-circulating information. However, because Hong Kong is already conceived of as a self-contained 'island' (located both physically and ideologically in-between Chinese and Western systems), it has a greater flexibility to 'choose' a course of action that 'fits' with its local circumstances and events. What Dr. Wang's stresses above is Hong Kong's ability to adapt quickly to changing circumstances – both locally and globally. Hong Kong is thus able to 'change' its 'strategy' based upon a floating identity and status as a competent public health authority.

We can better examine Hong Kong's positioning within global public health in the following excerpt.

> TM: How much of your experience, or how many of your lessons learned, are applicable outside of Hong Kong? Or do you think that Hong Kong is in a unique situation?
>
> Dr. Wang: *There are two kinds of answers here, I think. The more simplistic answer is really that a lot of lessons that we learned here in Hong Kong, whether in H1N1 or SARS, are pretty much applicable across different places. At least of the same economic development. We have the advantage of being a small place, a concentrated place, so in terms of surveillance, it's easier than in a big country like the U.S., where you have such a vast territory. So it's easy to get information in Hong Kong, we can get lab tests very quickly, and so on. So this is the virtue of being small.*
>
> *Other lessons like communicating with the public, or having a preparedness plan, a stockpile of medicines and vaccines, I think most countries are doing more or less the same thing. I've heard lectures given*

by Liam Donaldson, the chief officer of the Health Protection Agency in the UK, and it's strikingly similar to what we did in Hong Kong – both in terms of the things that they did as well as the problems that they face. And then, a very similar picture in Singapore. So I think a lot of these [measures] are standard stuff.

In answer to my question, Dr. Wang locates Hong Kong as a unique place inside a larger and more 'universal' or homogenizing global framework. As a former colonial possession and as an 'island' itself, it is perhaps unsurprising that Hong Kong's official health policies should be closest to that of the United Kingdom, or to the SAR's fellow postcolonial metropolis city-state, Singapore. What was more unexpected, perhaps, was Dr. Wang's further explication of Hong Kong's specific situation in a line of thinking that that led us inexorably back into another discussion of 'containment' – or quarantine.

Now, the other part of the answer is, indeed, there are some unique features in Hong Kong. It really depends on the circumstance. A typical example being containment. In Hong Kong, our situation was different because we did not have the first case in April. We put up a lot of defenses at the borders and so on. But we are obviously facing different kinds of situations, epidemiologically. I think that what the U.S. was doing was entirely justified in that sense, because containment doesn't make sense. It doesn't work when you have already community spread.

There were also a lot of misconceptions about border health measures, taking temperatures, filling in the declarations, and so on. I think people put too much faith in these measures. They may catch 50% of the cases, but the other half just go through unnoticed. People are not developing symptoms. But Hong Kong people demand that you put up your defenses. So at the end, there is pressure, and we do want to slow down the outbreak, so we put in place some border health measures. But at the same time it's important to tell people that we do everything we can, but it's not foolproof. Sooner or later it's going to come, and there is going to be community spread.

In this instance, Hong Kong's decision to quarantine is held up as an example of the city's unique situation. Containment then is representative of Hong Kong's special circumstances, not necessarily derivative of them. What's more, unlike the purely science-based explanation nearer to the beginning of our discussion, quarantine is depicted here as being both politically and culturally driven. In other words, if science itself did not exactly support containment measures for H1N1, public health officials felt a social pressure to act. Hong Kongers, from Dr. Wang's perspective, demand quarantine. Our discussion of Hong Kong's response actions then went on to clarify what I will term here the 'extra-scientific' reasoning behind Hong Kong's official decision to quarantine.

The second point about the uniqueness of Hong Kong is our proximity to mainland China. Because that featured prominently during the SARS

> *outbreak. Only this time, China is not the first place to get hit by H1N1. But our challenge, as I said, is because China has a different perspective and a different strategy for dealing with it. But we do have the same borders, so how do we harmonize with China in terms of how we handle cases? . . . One particular difficulty is with our borders. As you know, Hong Kong, we have a border with mainland China. It's one country, two systems. But China has a different strategy on H1N1. Right now, officially, it's still in containment phase. So we harmonize our port health measures with China.*
>
> *The trouble is, I think, that after SARS, everyone in Hong Kong got hyper-sensitive about infections. Of all sorts. OK? And you see them everywhere in the newspapers; they feature very prominently in the headlines. So the public expectation is very high. And they do expect the government to take a very proactive approach to handling these kinds of new infections. So in a sense, I have to balance the scientific reality with the public's expectations.*

So, in essence, Dr. Wang must be able to cope not only with the 'scientific reality' of the H1N1 outbreak, but with its social and political aspects or effects as well. The last passage speaks to the lived experience of practicing science in Hong Kong: an epidemiologist in the SAR must be cognizant of multiple realities at once; must be 'fluent' in each language, or able to 'code-switch' between these different worlds; and must 'balance' the expectations of several different realities at once by becoming an adept 'translator' of information. Hong Kong's past experience with SARS, as well as its geographical location – described here as being both one with, but separate from, mainland China – have thus created a distinctive situation for its public health professionals.

I want to stress here that Dr. Wang's willingness to give primacy to Hong Kong's relationship with China over that of the international community is crucial to understanding Hong Kong's developing role in emergent global networks. It signals that, at least on an epidemiological level, Hong Kong thinks of itself as being closer to China than to its other national partner agencies (such as the US CDC). And, perhaps indicative of this growing relationship, Hong Kong's official policy to quarantine was in agreement with the Mainland's own decision to take extreme preventative measures during the 2009 pandemic. Professor Gabriel Leung, Under Secretary for Food and Health, echoed Dr. Wang's rationale for quarantine in an article on SARS, arguing that: "Quarantine is unquestionably a necessary intervention in the event of an epidemic, but we need more analyses of the transmission of the disease between actual cases and their contacts before we can assess and quantify its benefits" (71). In the same article, Leung suggested that "internal politics" were often an issue during an epidemic, and remained an "outstanding problem for the Government" (75).

When I spoke to another top epidemiologist in the spring of 2010, he was very forthcoming and open with me about Hong Kong's use of containment as part of its response to the 2009 pandemic. Dr. Kuang's office was housed in a tall, silver, modern government building. Robert Kuang collected me from the visitors' area and led us back

through the office labyrinth to his large, well-appointed, corner office. We sat down on comfortable sofas to discuss the events of early May 2009, including quarantine.

To begin our interview, I formally introduced myself and informed him about the ENDS research project and my own fieldwork on influenza surveillance and virology in the SAR; he listened carefully, nodded occasionally, and interrupted me to politely ask follow-up questions about the goals of the ENDS project and of my dissertation. Then, after introducing himself only briefly, he asked me who else I had already spoken with in Hong Kong and who I had worked for inside the Western national health agency. This was his overt way of locating me in the network and of assessing – in advance – the quality of my information.[20] Here, as before, my floating identity as a former Hong Konger, a then-current UC-Berkeley graduate student played a key role throughout the conversation that followed.

In stark contrast to my relaxed conversation with Dr. Wang, my interview with Dr. Kuang was more rigid. Contributing to this was my lack of formal training in epidemiology and bioscience; my lack of expertise hindered me, I suspect, from gaining Dr. Kuang's full trust. As well, Dr. Kuang's dual role as a public health expert and top government official was not an insignificant factor in the continued formality of our conversation. As Under Secretary, he was more mindful of the tape recorder that I placed on the coffee table between us. As an ex-journalist, I know from experience that the phrase 'on the record' typically means something quite different to government officials than it does to scientists. Both of us were sensible to the possibility that Dr. Kuang's narrativization of events would become, by default, part of the 'official' account of Hong Kong's response to the 2009 H1N1 pandemic. Yet that was exactly what I had come, in part, to hear – the official story of and rationale for Hong Kong's early response to H1N1. What follows, as excerpted out from a much larger discussion of public health operations and practice in Hong Kong, is Dr. Kuang's explanation for implementing containment measures.

Robert Kuang:

> *Well, we have never really stopped border screening in terms of thermal screening, infrared thermal screening. We've never stopped since SARS. We also in particular targeted flights from North America at the very beginning. And I think that's been effective, and essential, at the earliest stages. The WHO phase four is where containment might just have a fighting chance. So that really corresponds to the earliest stages of the global spread, and, that's why we did all those things. And once we identify a suspected case, then of course, full infection control procedures*

[20] In chapter four, I detail the process of gathering and sharing information. Information exchange is a crucial component of relationship and trust-building within public health. It is reflective, in many ways, of a gift economy. I was often asked to give information before I received any. By asking me who my contacts and informants were, Dr. Kuang was, in essence, assessing the quality of the information I would have to share with him. I was not unaware that my access to his personal opinions were dependent upon my answer to his question. This ritual exchange of information always began my conversations or interviews with epidemiologists and scientists, regardless of location or their own position in the 'hierarchy.' Like gossip, information about what or how other agencies or people were thinking about the 2009 pandemic helped to create or cement personal ties within the larger, more 'official,' networks.

in handling that particular passenger or visitor or patient in terms of transport to a designated hospital unit for quarantine plus or minus isolation.

That was precisely 40 days after May 1. And of course that's where the term quarantine comes from. So the border screening and all those containment-like measures at the earliest days, post-May 1, in my mind, allowed us to delay the community spread, or extensive community seeding. Precisely for the period that the ancients had in mind, 40 days. So you quarantine and you buy 40 days. And my colleagues at the University studied this and mathematically showed that this was true. Most of the literature will tell you that border screening does not work, if your objective is to completely stop the introduction of infectious seeds. But what the literature also shows is that you can buy a few weeks, you can delay it a few weeks, and those few weeks could be quite crucial in terms of ramping up your community response in mitigation.

And if you look at the sociology and the population psychology, as a result of the 1997 H5N1 outbreak here, and the 2003 SARS outbreak, I think not having those initial containment-like measures, including school closures, would have been untenable. But of course not every population or society has the infrastructure, has the logistics, capabilities, and the population readiness to implement and support these interventions. So I'm not here to say that, universally, that is what every society or population ought to have done. What I'm saying is that it's a highly contextual decision, and that in our context, it was the right thing to do. And I remain of that view.

Hong Kong's decision to quarantine is initially explained in relationship to its past experience with SARS and its unique policy of continual temperature screening at its borders. Dr. Kuang also locates Hong Kong within a global framework here by arguing that containment is in agreement with WHO recommendations for early stages of an influenza pandemic. The proffered rationale for extending quarantine policy for a full 40-day period is then connected both to 'what the ancients had in mind' – part of an argument related to historical precedent – and to scientific data which suggests that containment measure allowed Hong Kong to 'buy time' or delay the widespread infection by a measure of days or weeks – part of an argument related to hard science. Lastly, Dr. Kuang effectively argues that the 'context' of Hong Kong – with its unique social and psychological characteristics – should not be ignored when making epidemiological decisions about the type of response that is 'appropriate.' Like Dr. Wang, Dr. Kuang suggests that Hong Kong's citizens demand quarantine, that they expect it, and that it is effective for delaying the spread of disease. The heavily contextual decision to quarantine, then, is located here in relationship to Hong Kong's floating identity as both a unique place and as part of a larger global public health network.

The perspective and beliefs expressed in the interviews above are paradigmatic of most Hong Kong public health officials, epidemiologists, and scientists doing work on infectious disease in the SAR. These exchanges symbolize the cultural politics at issue in

the recent public health responses to the 2009 H1N1 pandemic. More than this, however, they highlight the tensions inherent in Hong Kong's positionality as a 'unique' site within larger global networks. Hong Kong's interstitial position between cultures is used positively in the excerpts above to frame its official response to a global outbreak of infectious disease. Hong Kong's *cultural context* – as a SARS-survivor, a Chinese SAR, and a global city – becomes preeminent to its rationale for response.

Its relationships to the Mainland and to the West writ large, its floating local and global identity, has allowed Hong Kong to retain a certain ontological flexibility. That flexibility, in turn, was the foundational basis for the adaptability of its response during the pandemic. Hong Kong SAR is, in the words of Ackbar Abbas, a "para-site" – or in a place that is "both autonomous and dependent at the same time, a position in which autonomy is paradoxically a function of dependence" (74). It is precisely because Hong Kong's identity as a postcolonial or Chinese city is not fixed but slippery, because Hong Kongers are conceptualized as in-between being Chinese and Western, that it was able to fashion its own "Ideology of Order" (Watts 1997) during the 2009 H1N1 pandemic and beyond. In other words, Hong Kong's floating identity is the progenitor of its capacity to adapt quickly to shifting information and unfolding events during a pandemic. Resultant debates over the scientific solidity of Hong Kong's epidemiological reasoning – a debate over the effectiveness of quarantine that, in many ways, is almost entirely one-sided on the part of the United States CDC and the WHO – reveals an overtly 'Western' concern about the correct 'Chinese' translation or interpretation of scientific data. Moreover, it exposes lingering tensions in the so-called Western world over Hong Kong's political and cultural self-identification. In its official decision to quarantine, Hong Kong appears to identify as newly 'Chinese' rather than as 'Western' in its logic. Kwai-Cheung Lo has argued elsewhere that: "The significance of Hong Kong for the West lies in its challenging or subverting of an emerging China and also in its mirroring of a superior Western cultural identity and values" (15). Hong Kong's so-called identity crisis, then, can be read as a dual crisis – one in which both China and the West have clear political and cultural stakes.

Conclusion: The 'Imagined Community' of Global Public Health

In thinking about what it means to continue research (either social scientific or scientific) related to infectious disease in Hong Kong – especially influenza, with the city's charged historical association as the 'origin' of pandemics – I want to end this chapter with an echo of the question with which I began it: Why does Hong Kong's floating identity continue to captivate and concern us? It is not so much the question "Is Hong Kong China?" that troubles me here, but the fact that we continue to ask it at all. The answer seems so self-evidently important that it should make any scholar doing work there take pause. Hong Kong's association with infectious disease, its lingering 'identity crisis,' and its current position within global health and scientific networks highlight the ways in which the SAR troubles the creation and maintenance of easy global narratives about influenza, the practice and meaning of science, and the universal interpretation of epidemiological data. In our continual muddled efforts to conceptualize or analyze Hong Kong as a Chinese/Westernized/Asian/international city, I agree with Hong Kong scholar Ackbar Abbas when he argues that: "Hyphenation suggests a twist in cultural space.

What separates also connects" (110). This is true on multiple levels. It is Hong Kong's past as a diseased site for plague research that links it to its current role as a disease resource and locus of ground-breaking influenza research. Hong Kong's history as a British possession connects it to its present as a Chinese city. Or, as Kwai-Cheung Lo has argued, Hong Kong's Western-Chineseness underlies its unique position as the Switzerland of Asia – positioned as existing both "inside and outside of China" – thus making it representative of a "new understanding of Chineseness and its interplay with today's world" (2). This has clear implications for how we can think about the global, nationalism, postcoloniality, and identity in the 21st century.

In E.J. Hobsbawm's treatise on nations, the author reJamesed on how "interstitial centres of world trade" like Hong Kong were able to rebirth themselves – symbolic of how little the "ideology of nations and nationalisms" (182) mattered in the late 20th century. As a self-identified former expat from Hong Kong, I think this is a valid interpretation of what Hong Kong signifies for the 21st century. Hong Kong is not really an international city, nor a global city. Hong Kong is instead the first truly "transnational" city; or, rather, it is one concrete or phenomenologically experienced example of "the transnational itself in its becoming" (Lo 112). Indeed, Hong Kong is never "finished" and it never "is" – it is always in a state of becoming something else. The Hong Kong SAR is best conceptualized as an 'imagined community' that is political and limited but not sovereign (Anderson 1983, 6), an in-between space that overtly problematizes theories about the rise of nationalism. As such, it also throws a theoretical wrench into the engine of postcolonial studies.

While the Hong Kong SAR might arguably fit under the rubric of 'postcoloniality' as a condition – it was indeed a British possession for over a century – the territory and its populace are not as easily captured through the lens of 'postcolonialism' as a theory (for a clear differentiation of the these closely related concepts, see Gandhi 1998). For one, and as highlighted throughout this chapter, Hong Kong seems to have little overweening "desire to forget the colonial past" or "postcolonial amnesia" (Gandhi, 4). What is more, there is scant on-the-ground evidence that the SAR government is actively trying to "make a new start" post-handover (Gandhi, 4).[21] Hong Kong's long history of British, and now Chinese, rule highlights the ways in which the city and its denizens trouble the two 'postcolonial' positions of "contestation and its discomfiting other, complicity" (Gandhi, 5). Hong Kong does not need to be 'reminded' of its colonial past, nor does it with to break with it. Rather, Hong Kong's floating identity allows it to identify as both/and as well as neither/nor.

Hong Kong simply does not 'fit' comfortably inside any theory or system – be it postcolonial theory, theories related to 'identity' and nationalism, or the system of global public health. This is what makes the city feel so transient, slippery, and why it often instigates such cultural and political angst – on the level of global public health as well as on the level of international politics. As any Hong Konger will tell you, Hong Kong is always Hong Kong first; only the second identifier – global, international, Chinese, Asian, Western – is variable.

[21] One reason for Hong Kong's uneasy categorization as a 'postcolonial' city might be solely be the fact that Hong Kong is unique in that it was returned to its 'original' nation. Thus, it is not a post-colonial state proper because it did not gain any true sovereignty for itself post-handover. Instead of a becoming, then, Hong Kong experienced its postcoloniality as a return – two very different ontological states.

What the 2009 H1N1 pandemic simply highlighted, then, are some of these more persistent macro-level tensions. Hong Kong's containment measures flew in the face of international recommendations and revealed Hong Kong's growing identification with its 'Chineseness.' Yet the significant role that Hong Kong currently plays within global influenza and infectious disease surveillance, research, and response networks means that Hong Kong's actions matter to the development, creation, and daily functioning of future international systems of disease control. What Hong Kong does now, and more importantly, how Hong Kongers conceptualize those actions, becomes important not only for analyzing how culture or politics continues to affect public health outcomes and response, but for understanding the China's growing impact upon global policy. Hong Kong is China in the 21st century; recognizing and accepting that fact means that we will all need to rethink our attachment to any too-easy deployments of the East/West binary. In the global era, Hong Kong signifies much more than just 'Chineseness.' The SAR is an example of why each global metropolis might now be better viewed as a petri dish for the mixing of local, national, and international policies, beliefs, and values.

PART TWO：Unfinished Narratives of the H1N1 Pandemic and the Rewriting of a 'Global' Myth

In the Greek myth of Argus, well-crafted words and a pretty song have the power to waylay even the most wary of people from their immediate tasks and ultimate goals. The short tale of Argus is told as part of a larger narrative of infidelity, mistrust, and revenge. Commanded by Hera to watch over Io, Zeus' beloved mistress (whom he had turned into a white heifer to hide from Hera), Argus is depicted as a powerful and loyal giant with one hundred eyes covering his entire body. The giant is never fully 'asleep' since some of his eyes remain always 'awake'; Argus, then, is the perfect watchman, guard, and protector because he is ever-watchful. According to classicists Edith Hamilton and Thomas Bulfinch's separate retellings of the myth, Argus is ultimately slain as a result of listening to – and being lulled to sleep by – the words and songs of the messenger god, Hermes. But if Hermes' songs are pleasing to the ear and "soothing" (Bulfinch, 37), then in contradistinction to the myth of the Sirens' song, Hermes' words and stories are described as "especially tiresome" (Hamilton, 77). Hermes, in essence, bores Argus with his never-ending stories until Argus is unable to stay alert.

This is a particularly poignant tale to begin an examination of global narratives about influenza and the recent 2009 H1N1 pandemic. In Greek, Argus is also sometimes referred to as Argus 'Panoptes' – or 'all-seeing.' He is, then, representative of the first panopticon. Argus's power – at least in part – comes from his ability to see everything at all times. He is the first surveillance system, bid to keep a vigilant eye on an uncertain object. It is perhaps unsurprising, then, that one of the main sources of information on international disease outbreaks is an advanced surveillance system known as ARGUS. A program that is run out of Georgetown, ARGUS is a federally-funded surveillance system that aggregates and feeds information on outbreaks to analysts, epidemiologists, and public health officials. Like the Greek Argus, ARGUS never 'sleeps.' Advanced computer algorithms scan the internet for news or 'rumors' of the latest disease outbreaks in over 30 languages. Reports are evaluated by in-house staff at ARGUS, a summary is written, and the event 'alert' is then forwarded to experts within the U.S. CDC for further analysis. In a world of ever-expanding information, ARGUS produces scores of these reports on a daily basis.

During my time inside a national health agency, I observed the effects of panoptic global disease surveillance on the analysts working inside their global health division. ARGUS is only one of many systems and websites that epidemiologists regularly rely upon for the collection and sharing of information, including the Global Public Health Intelligence Network (GPHIN), and Pro-MED.. Effectively inundated by a stream of constantly updating information on an ostensibly never-ending series of events (big and small, certain and uncertain, unusual or routine), at times it seemed as if the analysts I worked with – much like Argus the all-seeing giant of Greek myth – would be lulled into a state of somnolence by all the information competing for their attention. Indeed, the people I knew or met with shared similar concerns. They worried about what they categorized as 'information overload' and complained of physical fatigue – a near-daily situation that was merely heightened at the peak of the 2009 H1N1 pandemic. How, they wondered, could they remain alert and vigilant if 'new' information on global disease outbreaks had no end, no pauses, no lulls? Would they 'fall asleep' at the helm of the ship

of global public health only to awake to a serious pandemic event such as SARS? Unlike Argus the mythical giant and ARGUS the technological system, analysts, epidemiologists, and scientists were all-too human. They could only do so much, think so much, hear so much, read so much before they needed rest, some time to think. With the demand to be ever-vigilant on the rise, how could they shut their eyes, even for a minute, without leaving themselves open to possible failure or political and popular blame? Sentinels, it seems, cannot afford to sleep, especially in the midst of a near-constant uncertainty about our epidemiological futures.

In the second part of this dissertation, I unpack narratives related to two of the more taken-for-granted concepts that comprise global public health's infrastructure: information and uncertainty. My examination of the global narratives surrounding uncertainty and unpredictability during the 2009 H1N1 pandemic, on the one hand, and information and context, on the other, ultimately help me to show how these narratives shape the most recent "conventions of practice" (Bowker and Star, 35) in public health. Outbreaks of influenza, particularly those that occurred during the initial moments of the 2009 pandemic from late March to early May, together constituted an event in which the infrastructures that undergird much of the day-to-day operations of global public health showed signs of strain. Overloaded with information and bogged down with response duties, epidemiologists and virologists everywhere were suddenly aware of the gaps and friction inherent in the 'new' global public health information and communication systems. These all-too public fissures had an ancillary benefit; the system under stress had the effect of making some of the more 'invisible' beliefs and practices of epidemiologists and scientists 'visible' even to an uninitiated observer (such as myself). Bowker and Star argued that: "One cannot directly see relations such as membership, learning, ignoring, or categorizing" (Star, 285). What one can see, however, especially during stressful events when responsibilities need to be renegotiated, are boundary infrastructures or "objects that cross larger levels of scale than boundary objects" (Bowker and Star, 287). I argue that information related to the influenza virus itself was one such boundary infrastructure. Focusing on how biological information about the H1N1 virus circulated and was discussed – both privately and in public – allows me to analyze the construction of larger 'global' narratives about both influenza and pandemics in general.

In the two chapters that follow, I suggest that these larger 'global' narratives about influenza and pandemics can be viewed, like other narratives, from multiple perspectives: literary, historical, and philosophical (Xin, 73). Borrowing from anthropologist Liu Xin's work on narratives, space, and time, I ask what the "elementary structure" (93) of a narrative of the 2009 pandemic might look like. In her work examining outbreak narratives, Priscilla Wald has argued that "the circulation of microbes materializes the transmission of ideas" and that through their work on pandemics epidemiologists "catalog the spaces and interactions of global modernity" (2). Even more important, however, is Wald's suggestion that such outbreak narratives have real consequences, not least of which are how an outbreak will be perceived and how seriously a disease threat will be taken (3). Epidemiological narratives in particular, then, are a type of "technology" (19) that helps to construct entire populations. Seen from Wald's perspective, then, the 2009 pandemic constructed a truly 'global' space, one in which we see "communicability configuring community" (12) on a global scale.

In this section I focus on the ways in which those working under the rubric of global public health narrativized the uncertainty and unpredictability of the situation in order to help them to make sense of the events unfolding around them. I concentrate on 'global' narratives here because, as Charles Briggs and Clara Mantini-Briggs have maintained elsewhere, these "stories are just as real as germs" (7) and "narratives make events" (77) – at least in part. I crudely summarize and then borrow their argument from *Stories in the Time of Cholera* to suggest here that throughout the 2009 H1N1 pandemic, discussions about influenza (both in print and in speech) were partially constitutive of the events themselves. Narratives about the cause, origin, spread, and genetic makeup of the influenza A virus known as H1N1 became as important to the collective understanding of the pandemic as the virus itself.

Chapter four examines the seemingly new paradigm shift within global public health from the use of a scientific certainty to a biological and situational uncertainty as one of the foundations of response to infectious disease outbreaks. During the recent 2009 H1N1 influenza outbreak, national and international public health officials often referred directly to the uncertainty surrounding both the virus itself and of the course, duration and severity of the pandemic. The vague and flexible concept of 'uncertainty' – especially as it was employed by top virologists and epidemiologists in relationship to questions about the predictability of the influenza virus – provided the scientific foundation for much of the rationale behind both national and international health responses to the global pandemic. Public health officials, epidemiologists, and scientists often deployed a type of 'strategic uncertainty' as an effective tool for gaining or retaining trust and scientific authority during the H1N1 pandemic.

Chapter five explores the concept of 'information' in public health through the lens of the recent 2009 H1N1 pandemic, beginning with an exploration of the ever-expanding definition of information in the 21st century. Relying on participant observation and data on information-sharing collected during the so-called second wave of the pandemic, I examine the various social, political and cultural aspects of the generation and circulation of epidemiological information. Public health professionals often stressed a reliance on informal personal relationships to fill in any information gaps in more official sources or networks. Successful past efforts to increase transparency and information flow in public health have accidentally created what many in public health refer to as a 'data deluge' and have also highlighted a significant new obstacle – that of getting access to the context deemed crucial to any decision-making process. Finally, I explore what people mean when they use the term 'context' and conclude by arguing that the problem of the 'data deluge' does not center on the creation of more or better information or technology, but in understanding how communication and personal interactions shape the production of 'good' or 'actionable' information.

Ultimately, both chapters when read together suggest that recent troubles in public health related to sustained uncertainty and the gathering and sharing of 'good' information or 'context' can – and should – be examined as part of the continuing anthropological focus on systems of beliefs and the production of knowledge. Scholar Patricia Wald has effectively argued that: "The outbreak narrative is itself like the epidemiological map and the electron microscope, a tool for making the invisible appear; it borrows, attests to, and helps to construct expertise" (39). The global narratives explored in this section show how uncertainty is effectively managed and then deployed

as a crisis management tool by public health experts. Expertise here is a conglomeration of individuals' collective past experiences and beliefs – or 'gut feelings' – about an outbreak of infectious disease. Expertise is not built out of 'facts' or certainty, but through a careful utilization of available information (both verifiable and ambiguous) coupled with a strategic deployment of sustained uncertainty. In the 21st century, experts now regularly admit to the gaps in their knowledge, share their personal opinions, and are learning to comfortably exist in the midst of a continual state of unremitting anxiety.

Within this new framework, narratives matter more than ever because they help both experts and 'lay people' to understand events that never seem to have a clear-cut beginning or ending. All the narratives about the 2009 H1N1 are then, at least from the perspective of the traditional narrative arc, *still unfinished*. At different locations and time periods throughout my fieldwork, the stories I heard and read about influenza seemed to lack a certain "narrative coherence" (to borrow a term from Liu Xin's work on business practices in southern China). It was not that the epidemiologists and scientists I talked with did not recollect what actually occurred during the 2009 pandemic or could not tell me "the story," but rather that they often had difficulty narrating smaller instances or moments of decision-making in any kind of "meaningful temporal sequence" (Xin, 102). Their oral retellings of events often jumped back and forth in time and space, with moments and information all linked together like some kind of aural hypertext. To understand what was happening as it unfolded in 2009, the public health experts that I worked alongside often shared stories of their experience with past outbreaks of influenza or SARS in an attempt to place uncertain epidemiological information back into some context or relationship to known facts. The stories that people told me were often filled with details which were meant to recreate for me the anxiety, excitement, and frenetic energy of the first few weeks of the 2009 pandemic. They were also, I would come to understand much later as I tried to make sense of what I had observed, representative of each individual's attempts to better understand and analyze events and actions.

By the end of 2010, I began to recognize that all the experts involved – social scientists, virologists, epidemiologists, and public health officials alike – continued to share and gather tales of the pandemic in order to comprehend something beyond our individual ken. Maybe if we pooled our resources, the collective logic seemed to go, we might be able to grasp at a larger truth about the effectiveness of and gaps in global public health systems. In trying to reconstruct events, in all the retellings, we found ourselves grappling with uncertainty, risk, various problems of access to good information, and a constant, overweening threat that we might all be lulled into a false sense of security by *too many* unfinishable narratives.

Chapter Four

A Predictable Unpredictability: the 2009 H1N1 pandemic and the concept of "strategic uncertainty" within global public health

> *Every outbreak is unique. Every new strain of virus is unique and until the outbreak has progressed you don't know what it's going to do and so it's a matter of making decisions with incomplete information.*
> *– Richard Besser, CDC Daily Press Briefing, April 2009*

All through the months in which I worked closely with and spoke to various scientists and policymakers, the term "uncertainty" was rarely used in normal day-to-day conversations, during teleconferences, or in the various meetings I attended. The people around me often discussed information gaps, or what they didn't yet know, and the sheer unpredictability of the virus itself. In the many informal conversations between colleagues that I observed, the talk frequently turned to questions regarding the severity of the virus and its biological makeup and origins, the problems in obtaining crucial clinical information from affected areas, or about the difficulty in ascertaining the "denominator" of cases – or the total of how many individuals had been infected with the virus. There was much that was unknown about the emergent outbreak, and efforts were constantly being made to ascertain as much information about the virus as possible in order to lessen this uncertainty.

Uncertainty is, of course, nothing new within the realm of science – epidemiology and virology included. The scientific process was crafted, at least in part, to deal with the rather slippery reality of uncertainties in the world beyond the laboratory. Scholars involved with or working inside the field of science and technology studies (STS) have often focused on the ways in which uncertainty in science is artfully turned into "socially-constructed" facts (see Callon 1999[1986], Knorr-Cetina 1999, Latour and Woolgar 1979, Shapin and Schaeffer 1985). Science produces facts and theories about the world through the practice of examining the realm of the unknown. Examinations of the daily practice of science have highlighted just how adept scientists are at utilizing the scientific method both to garner and to retain a certain authority in relationship to their subjects and fields. Indeed, I will argue throughout this chapter that scientific authority persists not despite uncertainty, but *because* of it. Uncertainty is the fertile ground for further scientific research and funding. Sustaining a partial uncertainty, grounded as it were in the ontological unpredictability of viruses, while being capable of both effectively managing that uncertainty and continuing the work of producing scientific facts – or certainty – about the virus, helped professionals working in global public health to maintain the current or reigning research paradigm. It is this *strategic utilization of uncertainty to positive effect* that is the focus of my examination of the 2009 H1N1 pandemic throughout this article.

In line with this thinking, then, one might make a valid point by arguing that an examination of uncertainty within public health is anything but new. Scholars of the themes of risk and preparedness have often pointed out how uncertainty is used within public health and policy circles to undergird planning and research paradigms to cope

with possible future biological threats or devastating pandemics (see Lakoff and Collier 2008). This type of uncertainty is conceptually related to a risk that occurs at some point in the future, but not one that is unfurling in the present moment. I will argue below that the meaning of uncertainty itself has shifted. Uncertainty as it pertains to risk and preparedness for a *possible* infectious disease event differs qualitatively from uncertainty as it pertains to risk in the present moment or immediate future *during* an infectious disease event. There is little risk of undermining scientific authority when admitting the future cannot be predicted (partially due to the fact that the specific infectious agent cannot be known in advance). Intuitively, one would surmise that there would be a much greater loss of authority as a result of admitting that the present moment was unpredictable because the disease agent itself, as well as the parameters of the developing situation, was not fully understood. This is why, in the not-so distant past, public health professionals were often loathe to openly discuss uncertainty. Throughout the early months of the 2009 H1N1 influenza pandemic, however, top public health officials regularly explained the uncertainty of the developing situation and appealed to the general public's understanding and patience. These pleas were often coupled with scientific explanations of the complex, ever-changing and ambiguous situation, with the influenza virus itself being cast as "predictably unpredictable" in its biology, behavior, and spread. Public health professionals habitually and liberally used the concept of "uncertainty" in official communications to justify immediate response measures or to preempt and clarify any future changes in recommendations and actions. In effect, then, scientific authority was at least partially maintained through *the strategic deployment of biological uncertainty* regarding the H1N1 virus itself.

In this chapter, I will first examine how biological science has effectively underpinned the rhetorical casting of the virus itself as innately "unpredictable." Analyzing scientific articles, media stories, quotes from top scientists and epidemiologists, and data gathered throughout my own ethnographic fieldwork, I will attempt to highlight how the influenza virus's predictable unpredictability – a term scientists and epidemiologists frequently used to describe the virus both in conversations with me and in the press (Altman 2009, Sepkowitz 2009) – is connected to the creation of a sustained uncertainty within influenza science. I will then move on to look at how other "information gaps" are linked to uncertainty during an influenza outbreak, analyzing a random selection of media reports and interviews as well as relying on my own experience working within a public health agency during the so-called second wave of the 2009 H1N1 pandemic. Finally, I will argue that the fostering and public expression of scientific uncertainty was used strategically to either gain or retain trust during the 2009 H1N1 pandemic. The frequent deployment of what I will term "strategic uncertainty"[22]

[22] My use of strategic uncertainty here is distinct from the term as originally coined within economic theory by Van Huyck, Battalio, and Beil (1990). As Donald Moynihan has explained it, strategic uncertainty in economic and management theory typically refers to a specific type of uncertainty that "arises because networks contain multiple actors who retain some measure of strategic autonomy, creating uncertainty about what choices they will make" (354). Thus, "strategic" is a qualitative term used to describe they type of uncertainty being experienced by actors in a network, "as the various actors seek to maximize their position in the network but know little about the intentions of other actors" (Moynihan 356). Strategic uncertainty as I utilize it here refers instead to the strategic *deployment* of uncertainty, where strategic is a descriptive term used in relationship to an actor's intentions when discussing uncertainty. My usage here

was, and largely remains, an effective method of retaining authority and control during an outbreak of infectious disease. Management of a sustained and partial ambiguity[23] or uncertainty in relationship to the production of scientific knowledge about the influenza virus itself becomes a tool here – with "strategic uncertainty" at the forefront of a new "epidemic order" in global public health.

The scientifically predictable unpredictability of influenza

As soon as rumors and media reports regarding an unusual, late-season outbreak of influenza in Mexico began to circulate in March 2009, international scientists and epidemiologists working on influenza in public health focused upon a set of objectives that related to gaining a better understanding the virus itself. First, public health agencies sought to obtain samples of the virus; next, virologists began to subtype those samples in order to ascertain which specific strain of influenza virus was causing the outbreaks; concurrently, evolutionary virologists began an immediate, international and collaborative effort to genetically sequence and analyze the virus in order to better understand its origins. Many public health experts believed that knowing more about the genetic makeup and origins of the influenza virus might help them to make not only better predictions about the severity and spread of the virus, but about the scope of the burgeoning pandemic. Thus, gathering information about the biology of the virus itself was crucial not only to the analysis of events as they unfolded in Mexico and in the southernmost states of the United States, but to the ability of public health experts to predict the immediate future.

By the end of April, it was evident to many of the virologists and epidemiologists who specialized in influenza that something big in scale was unfurling. An influenza pandemic was at hand. The question then became, how bad would it be? At this stage, data regarding the severity of the H1N1 virus mattered. Severity, however, is not a concept that is easily defined, especially as it related to the 2009 H1N1 pandemic. Generically speaking, understanding severity involves knowing something about a virus's virulence and transmissibility, as well as the ability to calculate the percentage of severe cases or deaths out of the total number of persons infected. Information that pertained to severity was hard to come by, especially in the first weeks of the pandemic, and people I spoke with often complained about the absence of "good data" on the total number of infections. The "problem of the denominator" and better data regarding the biological attributes of the virus itself were often cast in the conversations I had with public health experts about the early days of the pandemic as *the* key pieces of information that epidemiologists needed in order to recommend an appropriate set of responses and often

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relates, then, to how uncertainty itself becomes a rhetorical device or narrative tool for retaining scientific authority during the pandemic.

[23] I first began thinking about the role of ambiguity in public health after a correspondence with Dr. Linsey McGoey regarding a 2009 workshop she organized at the University of Oxford's Said Business School, entitled "Strategic Unknowns: The usefulness of ambiguity and ignorance in organizational life." The conference examined the various political, economic and social uses of ambiguity and ignorance in a variety of fields and sites. The economic concept I use throughout this chapter, "strategic uncertainty," is in many ways an outgrowth of my engagement with the idea of the "strategic unknown." Ambiguity here is used to refer to the opacity inherent to the *production* of scientific information, whereas uncertainty is used to denote an ontological property of the *knowledge* produced about the virus itself.

chronically lacked. One of the biggest problems seemed to be the "unpredictability" of the virus. This rather predicable unpredictability would become central to the story that was developing about the 2009 H1N1 pandemic.

In an analysis of the characteristic stories or "narratives" constructed about infectious disease outbreaks, scholar Patricia Wald has suggested that: "As epidemiologists trace the routes of microbes, they catalog the spaces and interactions of global modernity" (2008, 2). Going further, she adds that "the outbreak narrative is itself like the epidemiological map and the electron microscope, a tool for making the invisible appear; it borrows, it attests to, and helps to construct expertise" (Wald 2008, 39). Following Wald's lead, then, I argue that it is necessary to read closely and begin to critically examine the "narratives" about unpredictability and uncertainty at the heart of the 2009 H1N1 pandemic. By doing so, we can begin to unpack how the representation of the virus as unpredictable was strategically utilized – operating at least in part as a rhetorical tool – to maintain scientific authority throughout the pandemic.

From the start, uncertainty about the virus was rife.[24] Some of the first media articles published about the outbreak highlight how the virus itself was being cast as intrinsically unpredictable. One of the earliest stories on the pandemic in *Science* suggested that: "Much confusion surrounds the origins of the virus, why it seems to cause severe disease in Mexico and not elsewhere, and the overall threat it poses to the world. 'Right now, there's more unknown than there is known,' says microbiologist Francis Plummer" (Cohen and Enserink 2009a, 572). This particular article, first published on May 1, goes on to quote the then-acting CDC Director Richard Besser as attesting to the fact that decisions were being made based on "incomplete information" (Cohen and Enserink 2009a, 573). The very next week, *Science* again reported that although information was being collected and shared internationally – and at an unprecedented speed – there continued to be many "mysteries" about the virus (Cohen 2009). A segment on the developing situation first broadcast on May 1 and then published on NPR reported that: "Experts still lack critical information about the virus" (Silberner and Greenfieldboyce 2009). An article in *The New York Times* during the first week of the outbreak emphasized the fact that even the WHO had admitted uncertainty about the virus, stating that: "The World Health Organization said over the weekend that the new swine flu virus had the potential to cause another pandemic, but that it had no way of knowing whether it actually would" (Altman 2009). Within the same article, the virus itself was being blamed for the uncertainty, while the authority of the scientists was upheld. The journalist explained that: "For all that scientists have learned about influenza since the catastrophic pandemic of 1917-19, one thing has not changed: the predictably unpredictable nature of the viruses that cause it" (Altman 2009).

The virus in these narratives is often described as a "mystery" – the implication being that unpredictability is an ontological property of the virus itself. That unpredictability, in turn, leads to an operative condition for "uncertainty" for public

[24] I do not mean to suggest that uncertainty about the influenza virus or the pandemic itself was wholly manufactured. The public health experts that I interviewed felt that there was much "uncertainty" about both the virus and the events themselves – especially during the first few months of the pandemic. What I find most interesting – and what I will focus on within this article – is how they spoke about or deployed that biological uncertainty to positive effect, and how uncertainty was partially managed by transforming it back into certainty about the unpredictability of viruses.

health. It is not inconsequential that the situation with influenza is consistently cast as inherently unpredictable; there is no end to uncertainty in this formulation. Indeed, there is also no clear beginning, as the virus was consistently put in a comparative frame with other pandemic influenzas viruses from the past. A scientific article published online in *Science* on May 11 stated that "although substantial uncertainty remains, clinical severity appears less than that seen in the 1918 influenza pandemic but comparable with that seen in the 1957 pandemic" (Fraser, et. al. 2009, 1557). Here, scientists have begun to analyze the "uncertainty" of the 2009 H1N1 virus in relationship to other viruses with the same or greater amounts of "unpredictability." The scientists collectively argue that: "There are uncertainties about all aspects of this outbreak, including the virulence, transmissibility, and origin of the virus, and this in turn results in uncertainty in judging the pandemic potential of the virus and when reactive public health responses, such as recommendations to stay at home or to close schools, should be implemented in individual countries" (Fraser, et. al. 2009, 1557). Uncertainty is mentioned no less than five times throughout the text of the article, but still voices a confidence that "uncertainty should diminish rapidly in coming weeks as more data on severe cases in the United States and other countries becomes available" (Fraser, et. al., 2009, 1560).

By the end of May, two months after the beginnings of the pandemic, the statements about the unpredictability of the virus by and among scientists were already legion. *Science* reported that data on the virus remained "fuzzy" and quoted a prominent epidemiologist saying that: "'There's nothing more predictable about flu than its unpredictability'" (Cohen 2009a, 997). In the same article, renowned virologist Robert Webster argued that: "'You can't lay down rules for flu viruses – they'll break them every time. It's almost as though the virus reads them and says, 'I'll do the damn opposite'" (Cohen 2009a, 996). As Ann Schuchat of the CDC stated: "'We're at early days in understanding this virus. . . . It is early days, and with influenza, we always want to be humble and know that things can change and it can be unpredictable'" (Silberner and Greenfieldboyce 2009).

A little less than a year later, by late February 2010, the public consensus seemed to be that the pandemic was all-but over. Infection rates were low and a so-called second wave had never really materialized. Hundreds of thousands of vaccines the world over were left unused. But even so, uncertainty regarding the virus and the H1N1 outbreak not only lingered in the scientific realm, it seemed to be actively promoted. Reporting on a news teleconference, a HealthDay article quoted several top epidemiologists as warning against a too-easy "dismissal" of H1N1, or having a "false sense of security." A professor of public health argued during the conference that: "'The flu is very hard to predict and what you think you know is only what happened before. There can always be a surprise'" (Gardner 2010). *Science* called H1N1 the "virus of the year" and suggested that it would "go down in history more for causing confusion than catastrophe" (Enserink and Cohen 2009). And Carl Zimmer, a prominent science writer, wrote in his blog for *Discover Magazine* that the flu strain was "nothing if not surprising," both in the form of its emergence and the fact that by February 2010 – the middle of the traditional flu season in the northern hemisphere – H1N1 had "dwindled away to very low levels and stayed there" (2010). In other words, the virus was unpredictable not only for its makeup and its severity, but for the pattern of its spread and disappearance. Zimmer argued that the virus "continues to move enigmatically ahead of our understanding" (2010).

Of course, scientists and public health experts are not only accustomed to coping with the various difficulties in dealing with uncertainty, but well-versed in the more overt strategic and political uses of uncertainty as a device for the retention of authority. In an article on uncertainty published in the American Journal of Public Health in 2005, the co-authors working in public health stressed that: "In our current regulatory system, debate over science has become a substitute for debate over policy" (Michaels and Monforton 2005, S45). The focus of the article is the use of uncertainty by defendants in environmental health lawsuits or public hearings, but the issues discussed in relationship to the environmental arena can also shed light on similar types of arguments and debates regarding infectious disease (vaccine debates and the charge of undue influence within the WHO as pertinent examples). The authors acknowledge that while much of public health policy is grounded in uncertainty, public health practitioners must recognize that fact while still using the "best evidence available" for their decision-making.

Responding to the charge[25] that the WHO exaggerated the threat from the H1N1 virus, the WHO writes that: ". . . influenza viruses are unstable and can undergo rapid and significant mutations, making it difficult to predict whether the moderate impact would be sustained. This uncertainty, which persuaded WHO and many national health authorities to err on the side of caution, was further enforced by the behavior of past pandemics, which varied in their severity during first and second waves of international spread" (WHO 2010). In the response to its critics, the WHO discusses its evidence and data, but openly discusses the underlying biological uncertainty of the virus itself. This adept rhetorical move distances the organization from the source of the uncertainty, instead locating it within the realm of nature or biology. More research on the virus will thereby be required in order to better understand the severity of influenza outbreaks in the future. The scientific authority of the WHO is thus kept intact, even in the face of a sustained uncertainty.

In part, these "strategic" deployments of uncertainty work because the uncertainty is often displaced onto "nature" or on "society" (Shackley and Wynne 1996) – entities such as the virus itself or the general public – both perceived as inherently out of the control of the laboratory or field epidemiologist. Trevor Pinch's seminal work on certainty in solar neutrino science (1981) showed how scientists often pointed to other disciplines or fields working on the same problem as the source of uncertainty. The scientists' confidence, or certainty, in their own work or discipline remained unshaken under this formulation. In the case of virologists, epidemiologists and other public health experts during the 2009 H1N1 pandemic, uncertainty was primarily displaced upon the virus itself, with the virus being cast as biologically unpredictable. This unpredictability works, however, because unpredictability in the case of influenza is ultimately predictable. Thus, the creation of certainty *about* uncertainty becomes an effective method of retaining scientific authority during the pandemic. In the next section, I will

[25] On June 3, 2010, the British Medical Journal published a feature article on alleged conflicts of interest within the WHO during the 2009 H1N1 response. In the article, BMJ features editor Deborah Cohen and investigative journalist Philip Carter suggested that the WHO's reputation had been damaged by their lack of transparency and reluctance to publicly disclose the names of the key scientific advisors on influenza during the pandemic response. Some of these scientists have been shown to have connections with or to have taken payments from pharmaceutical companies responsible for manufacturing not only influenza vaccines, but drugs used in the mitigation of flu (such as Relenza). The quote used below was part of the WHO's official response to the BMJ article published on June 10.

explore how uncertainty concerning the virus itself expanded out into conversations regarding the overall ambiguity of the present situation, risk and the process of decision-making during an outbreak of infectious disease.

Expanding uncertainty: "information gaps," risk, prediction and expert knowledge

Much of the language used in the section above by public health professionals to describe the influenza virus during press interviews focused on terms such as "uncertainty" and "unpredictability," but a more generic uncertainty was also revealed in relationship to other "information gaps." Scientists and public health officials often privately grappled with what they viewed as a constantly changing and largely ambiguous situation. In the private meetings or conversations that I observed, public health experts often used phrases such as "we think" or "it seems" rather than "we know" or "it is" to reflect their own doubts about the type and quality of the information they had access to or were deriving from the various graphs, tables, charts, maps and case counts that were in circulation throughout the 2009 H1N1 pandemic. Although much of the locus of doubt remained centered on the "biology of the bug," uncertainty quickly expanded out to include other aspects of the pandemic.

While working within a national public health agency in the fall of 2009, I attended several meetings or teleconferences that pertained to the 2009 H1N1 pandemic. By October, the public health experts that I worked with were feeling the full effects of the "damned if they do, damned if they don't" paradox within public health (Altman 2009) – the precariousness of either sounding a false alarm or under-reacting in the wake of the discovery of a widely-circulating and novel influenza virus. The key to certainty during a pandemic is accurate information or data – data which epidemiologists everywhere lamented they were lacking, especially during the early weeks of the pandemic. Information was being circulated in a transparent manner. In fact, many public health experts felt that they were "drowning" in data, but that little of it was "actionable" or usable. By using the term "actionable," public health experts were expressing their frustration that official case counts and other "numbers" being shared did not provide any clarity on the overall situation during the pandemic. At stake was the ability to predict the immediate future and issue recommendations for action.

In interviews with public health experts during the latter stages of the 2009 H1N1 pandemic, I often brought up the topic of uncertainty in relationship to information gaps and risk in order to understand – in more specificity – what public health experts meant when they utilized the term. These conversations often shed much-needed light on how uncertainty was deployed, both in a general sense and in the bounded realm of influenza research and prevention. I discovered that there was a disparity between what people working in public health meant by the usage of the term and how uncertainty was perceived in the popular media or the general public. The tension between understanding uncertainty and the ability to make predictions during an outbreak was often highlighted. During discussions about uncertainty, public health experts frequently described what they saw as essential to understanding the unpredictability of an outbreak of influenza. These conversations did not necessarily center around the unpredictability of the virus – although that never really disappeared as a concern – but around the comprehension of risk vis-à-vis the inbuilt unpredictability of an influenza pandemic. In essence, the public

health experts I spoke with told me time and time again that there would never be "certainty" during an outbreak of influenza, no matter how much they knew about the virus or the current situation.

The following excerpt from one of my interviews reveals the underlying "problem" with using objective data to make predictions during a pandemic:

> TM: I'm not sure I understand uncertainty. And I don't think I understand probability and risk.
>
> Michael: *Well, even scientists really don't understand risk.* [laughter]
>
> TM: Statistics are a hard thing . . . I mean, intellectually, they are easy to understand, but they are not an easy thing to apply.
>
> Michael: *That's right, that's right. And uncertainty is the real big one, because, you know, whenever you see the media reporting numbers, it's just 'numbers as truth.' But actually there's always a lot of uncertainty about what numbers really mean. When they go up and down, people would like to have a lot of interpretation about why they go up or down. But quite often, it can be random variation.*

What becomes important here is the *understanding* of the "numbers" or various epidemiological data as it relates to uncertainty, risk and the ability of public health professionals to predict the immediate future during a pandemic. Numbers here are not as "objective" as one might first conjecture, despite the fact that they are the lingua franca of epidemiological science. If these numbers ultimately form the basis for many of the decisions being made during a pandemic, then what does it mean when the public health experts themselves admit that the data is itself imbued with a certain amount of uncertainty? Uncertainty here is pre-packaged in; it adheres to the data.

An internationally recognized scientist cautioned me about the dangers of using such information to make predictions about how a pandemic might unfold. As Professor Sam Jones explained to me:

> *You can look into the past, but you can't look at the future. To make a prediction about the future, you've got to get the virus, put it into a ferret or some other animal model, see if it kills them, look at how many . . . look at mortality and what virulence and what transmissibility and then you can make some sort of prediction*.

Again, uncertainty about the course of a pandemic is rhetorically tied to the actions of the virus itself. The virus here needs to be observed directly in order to know something about how it works. The past only provides a guide for what may happen during the present, but can never predict the future. Everything here is about *comparison* – either with the past or with other locations during the same time period. Without comparison, there can be no sense-making in the present tense. A chronic lack of comparative data – just think of the debate over the number of fatalities compared with the total number of

cases, or the "denominator debate" – often leads to confusion about the immediate future and a continuation of uncertainty. As one top public health official currently working in Asia explained it to me:

> *We always talk about objective evidence and objective data. In the real world, they don't come in handy. There's always going to be important data gaps, knowledge gaps, even interpretation gaps. So it's never a perfect situation in which to make decisions.*

In a real sense, then, what this last quote uncovers is the construction of a type of *sustained* uncertainty within public health in relationship to infectious disease outbreaks. No matter how much data (quantity) or how "objective" the data (quality), there will always be a "subjective" (interpretation) gap that leads to uncertainty during an outbreak. When I asked if this type of uncertainty would be repeated – ad infinitum – into the future, the official responded that it *certainly* would. Thus, information not only about the influenza virus, but other epidemiological data produced during an outbreak, simply feeds back into the uncertainty loop.

In response to the criticisms from the British Medical Journal in June 2010, the WHO rejected wholesale the idea that the pandemic had been "hyped" in collusion with vaccine manufacturers. In the briefing note released on June 10, the WHO reiterated the evidence-based claim that severity of an influenza outbreak is variable – and can change in regards to time, place and population. At first glance, the briefing looks like a typical case of post-hoc fact formation, with the WHO presenting documentation to bolster its case. Looking more carefully, however, one can see evidence of strategic uncertainty being expertly deployed. Severity is difficult to pin down because it requires a case-by-case *interpretation* of the data. It is the formulation of uncertainty as part of the permanent process of public health that interests me. How has uncertainty become one of the key components of global public health's rationale for its response to the 2009 H1N1 pandemic? More importantly, what does this collective turn toward or partial embracing of uncertainty signal? In the next section, I will begin to answers these questions by exploring how uncertainty is deployed as a strategic tool to retain scientific authority.

Strategic uncertainty and the maintenance of scientific authority during a pandemic

By the end of 2009, little "uncertainty" was still being expressed – either publicly or privately – concerning the duration, severity or overall course of the H1N1 pandemic. The 2009 H1N1 pandemic had, by all accounts, turned out to be similar in severity to that of a "normal" or "mild" flu season. Facts were known; a collective sense of scientific "certainty" regarding certain aspects of the pandemic – about the biological makeup of the virus, information concerning severity and its potential duration, and the immediate risk it posed to society – had all-but resumed. Many of the scientists and epidemiologists that I interviewed as late as May 2010, however, expressed a continued uncertainty relating to the H1N1 virus itself. From a virology standpoint, some public health experts worried openly that there might be an antigenic shift or a recombination event that could transform the H1N1 virus into something more ominous. In conversations throughout the latter stages of the pandemic, public health experts consistently used this uncertainty –

the predicable unpredictability of the influenza virus – to support not only their past and future decisions, but their present actions as well. In what follows, I will use the U.S. CDC and the WHO's deployment of uncertainty about the H1N1 virus during different phases of the pandemic to suggest that a new type of *strategic uncertainty* was being used within global public health as an effective rhetorical tool to retain scientific authority *during* this infectious disease event.

From the very beginning of the pandemic in April, CDC officials began to communicate uncertainty about the situation (see first section above). The then-Acting Director of the CDC, Richard Besser, stated that the agency's overall objective during the event was to "'tell everything we knew, everything we didn't know and what we were doing to get the answers'" (Maher 2009). In an article on the crisis communication style of Richard Besser, the journal *Nature* praised Besser's management of the situation, noting how Besser's overt use of uncertainty helped to shape the tenor of the entire U.S. response. The article quotes several prominent members of the international public health community as attesting to Besser's overall skill in "communicating uncertainty" (Maher 2009). Even noted expert on the 1976 influenza pandemic, Harvey Fineberg, argued that the CDC's communication of uncertainty during the pandemic under Besser was exemplary (Maher 2009). Although the Nature article also argues that Besser had miscalculated the "political ramifications" (Maher 2009) of the CDC's more aggressive early actions (such as recommendations on school closures), the fact that Besser himself was able to parlay his communication of uncertainty into several lucrative job offers should be seen as objective evidence that his strategic use of uncertainty was effective. In his current job as the health analyst for *Good Morning America* on ABC, Besser "still projects uncertainty" (Maher 2009).

My own interviews with public health experts outside of the United States support this view of the CDC's handling of the pandemic. The CDC was rarely overtly criticized. Instead, the CDC's strategy of "saying what you don't know" had been actively replicated in other locations. Public relations experts have actively coached public health experts in the art of crisis communication, advocating honesty and transparency over the projection of absolute authority. In a private conversation about the focus on uncertainty throughout the pandemic, scholar and former journalist Thomas Abraham suggested to me that the CDC – as the reigning "gold standard" of epidemiological science with a global reputation to match – had utilized the concept of uncertainty more often, and with more impunity, than other national or international health agencies had dared. It is interesting to note here, then, that the CDC has not come under the same scrutiny or criticisms as the WHO for its response to the pandemic.

In June 2010, the British Medical Journal published an investigative article that suggested the WHO's lack of transparency in its decision-making process and its cadre of experts' various links to pharmaceutical companies had led to various "conspiracy theories" about the WHO's handling of the 2009 H1N1 pandemic (Cohen and Carter 2010). Also at stake was the WHO's decision in May of 2009 to change its definition of a pandemic, striking a key phrase that had described a pandemic as an outbreak causing an "enormous" number of deaths. The authors of the article blamed, in part, the WHO's poor communication of risk, quoting one expert in risk communication as stating that: "'The problem is not so much that communicating uncertainty is difficult, but that uncertainty was not communicated'" (Cohen and Carter 2010). Responding to criticisms

that the WHO "overreacted" and "inflated risk" during the early weeks of the outbreak, the United Nations' influenza expert Keiji Fukuda argued that the pandemic was not over yet, and that the risk was "real" (United Nations News Service 2010).

Uncertainty during an infectious disease outbreak is by its very nature undisciplined and anxiety-provoking. Uncertainty is not easily managed, either within the confines of a laboratory dealing with the virus or in the world-at-large coping with an outbreak. All of the various scientific and epidemiological graphs, tables, maps and lists of numbers showing lab-confirmed H1N1 cases that were produced throughout the pandemic to track the peaks and valleys of the flu season were partial attempts by public health experts to alleviate some of the uncertainty surrounding the influenza virus itself. This creation and circulation of knowledge about the immediate or distant future – or "anticipatory knowledge" – is an attempt to wield authority over uncertainty, to make the unpredictable more predictable, to "project" competence and power, to create order out of potential disorder (Nelson, Geltzer, and Hilgartner 2008). As scholars of the 2009 H1N1 pandemic have pointed out elsewhere, both politicians and public health officials have opted for two rhetorical moves, often in the same sentence, that functioned to sound an alarm and to reassure the public about epidemic events (Nichter and Briggs 2009, 191). In practice, the scientists must walk the fine line between under and overstating uncertainties in relationship to a politically-charged issue (Shackley and Wynne 1996, 278). Reports on the 2009 H1N1 pandemic constituted metapragmatic accounts (Nichter and Briggs 2009)—or accounts of the accounts—of how epidemiologists, clinicians, and others produced and circulated knowledge. Looking critically, then, at the narratives around the uncertainty of influenza, we can see that a certain type of "anticipatory uncertainty" is being deployed. Wald has argued that "the epidemiological narrative is, like the microscope, a technology" (2008, 19).The construction of sustained uncertainty – both now and in the immediate future – provides scientists with a certain flexibility, a maneuverable bracketing of the future that is used to help control the present moment, a narrative tool for both gaining and retaining scientific authority during an outbreak of infectious disease. What cannot be known *now* can be further researched, it can be known *later*. In this deft move, a certain amount of biological uncertainty does not trouble scientific authority, but helps to further generate it.

In an article looking at uncertainty in relationship to climate science and environmental policy, Shackley and Wynne suggested that uncertainty has its uses, especially for scientists; uncertainty acts as an "alibi," a way to support further research funding, and as a hedge against the "encroachment" of policymakers into their realm of expertise (Shackley and Wynne 1996, 277). Uncertainty is negotiated in the semi-public interactions between scientists, policymakers, and politicians (Shackley and Wynne 1996, 277). Brian Campbell has argued the very existence of uncertainty is evidence of "continual interpretation and negotiation" (1985, 430), and that scientists who are asked to perform the role of expert in public hearings commonly "state that there is uncertainty, and that this type of argument can be managed and accepted as authoritative" (Campbell 1985, 431). Campbell argues that this "maneuvering in relation to uncertainty demonstrates a *strategic* importance of the issue of uncertainty to expert arguments" (1985, 445). I take his use of strategic seriously, as well as his suggestion that the strategic use of uncertainty reveals the politics inherent in policy science. For Campbell, uncertainty is not the cause of policy debates, but the result of such arguments (1985,

447). Uncertainty is a *flexible tool* that aids in negotiation of authority. The 2009 H1N1 pandemic might be seen as a "boundary-ordering device" (Shackley and Wynne 1996, 280), where uncertainty helps to redefine the authority of both scientists and epidemiologists. In essence, the strategic use of uncertainty allows the construction of a type of "certainty *about* uncertainty" (Shackley and Wynne 1996, 281). In turn, the policymakers can use uncertainty in a strategic way to "deflect unwelcome attention and criticism of the policy process" (Shackley and Wynne 1996, 283). All of this does nothing to undermine the authority of science. Indeed, the strategic use of uncertainty strengthens that authority. Science is once again seen as the only method to close a critical "information gap", and the authority of the current scientific paradigm further strengthens the reigning "policy order" (Shackley and Wynne 1996, 287).

Claiming that there is uncertainty is in no way an admittance that the scientist is in no position to judge – quite the contrary (Campbell 1985, 449). In fact, the strategic deployment of uncertainty guarantees that the scientific authority will be maintained, casting the scientist/epidemiologist as the only person qualified to judge an uncertain situation. They know *better*, if they do not know *all*. They have the tools to know further, to gather more information. In essence, if uncertainty somehow necessitates a return to certainty, then the strategic use of uncertainty ensures that science will be the discipline asked to shepherd us back to more solid, or certain, ground. But as Campbell points out, the "problem" of uncertainty cannot be dealt with quantitatively; it is a "social" problem (1985, 450). It was the rhetorical trick of deploying uncertainty during the 2009 H1N1 pandemic that has so deftly maintained the need for more qualitative data to interpret the pandemic.

STS scholar Susan Leigh Star has studied the ways in which "local uncertainties" are transformed into "global certainty", or facts (1985). In Star's epistemology, belief is a core facet of the ability of working scientists to transform uncertainty into certainty. As Star points out at the beginning of her analysis, "scientists constantly face uncertainty" (1985, 392). This is, of course, no less true thirty years later than it was when Star first began to study uncertainty as a phenomenon. However, Star's article also reflects the sea change in scientists' relationship to uncertainty. Star's work centers on how various types of uncertainty were completely elided from published scientific work through six mechanisms for creating global certainty: attributing certainty to other fields; maintaining that technical failures were to blame, rather than the internal processes of science; the creation of ideal types; shifting evaluation criteria to mask uncertainty; generalizing results in an ad hoc manner; and using internal debates or arguments over *how* to perform research to "subsume" uncertainty about *whether* to perform research (1985, 407-412). All of this "management of uncertainty" in the local setting had to "satisfy local constraints *and* create global certainty" (Star 1985, 413).

In effect, what Star argued in the 1980s was that local uncertainty formed the basis of a global certainty about scientific facts or the value of entire global research paradigms. This was one of the reasons why scientific theories about the world could persist well into the future. The transformation of uncertainty into certainty was the most efficient tool for sustaining a scientific paradigm indefinitely. In 2010, however, the meaning of uncertainty itself has begun to shift. Uncertainty is no longer the "dirty secret" of science. To reflect this, I want to take Star's old argument and flip it to argue that *sustained uncertainty* is now what ultimately holds the global influenza research

paradigm together. Strategic uncertainty does not necessarily need to be transformed into certainty in order for it to form the basis of a robust research paradigm. The CDC and WHO public responses to the 2009 H1N1 pandemic are examples of how effective the deployment of strategic uncertainty can be for the retention of authority during an outbreak of infectious disease.

Conclusion: strategic uncertainty and the creation of knowledge in global public health

> *Uncertainty is the only certainty there is, and knowing how to live with insecurity is the only security.*
>
> – *John Allen Paulos*

As medical anthropologists and observers of global public health, we are often no strangers to the deployment of strategic uncertainty ourselves. In recent editorials on the 2009 H1N1 pandemic, anthropologists have effectively argued that what biological and epidemiological approaches to infectious diseases lack is a social or cultural component (see Atlani-Duault and Kendall 2010, Singer 2010). These prominent scholars are not so much critiquing influenza science or global health response *per se*, but rather suggesting that their own area of expertise should be more efficiently utilized in order to fill up any critical gaps in data about how different socioeconomic groups or cultures cope with pandemics and public health measures. They are arguing for inclusion in the larger scientific paradigm based on their own social scientific authority, deploying the concept of uncertainty to strengthen the case for their own discipline's analysis of pandemics. Anthropology here is conceptualized as another effective tool for dealing with present and future uncertainty.

This chapter has been, in part, an attempt to ask a new kind of question about certainty and uncertainty within global public health. Can we be "certain" about "uncertainty"? How might uncertainty be sustained and utilized in relationship to the maintenance of scientific authority? Is this a new form of uncertainty or simply a new and more robust use of it? And, perhaps most importantly, how is the fuzzy line between biological "certainty" and "uncertainty" continuously renegotiated and/or maintained by the various scientists, epidemiologists, and other public health professionals working within public health?

Building out from the German philosopher Ludwig Wittgenstein's last statements on certainty, the concepts of certainty and of knowledge are not all that different (1969, 3e). Under Wittgenstein's formulation, certainty occurs the moment when someone "declares how things are" (1969, 6e). During the recent 2009 H1N1 influenza pandemic, public health experts declared vociferously and repeatedly that the situation was somehow fundamentally, naturally, biologically uncertain. In this chapter, I have attempted to examine how the meanings of words like uncertainty have shifted, how other concepts have changed along with them (Wittgenstein 1969, 10e), and how they might then be used to craft a new type of epidemic order. If we take seriously Wittgenstein's postulation that "a meaning of a word is a kind of employment of it" (1969, 10e), then we must begin to further examine how the scientists and epidemiologists working in global public health utilize the term uncertainty in daily

practice: what it might signify when it is used casually in relationship to ongoing scientific work and attempts to gather epidemiological data; what it might signify when it is deployed within the public sphere; and, finally, how it is might be utilized strategically vis-à-vis scientific authority. This is not to argue, however, that present-day scientific authority rests solely upon the maintenance of uncertainty. Now, as ever, scientific expertise is firmly located in the ability to produce facts, or certainty, about the world in which we live. My goal in this short space has been to point out how a new configuration of scientific authority within global public health straddles the ever-tenuous line between certainty and uncertainty, and to examine how biological uncertainty was deployed at key moments during an infectious disease outbreak to bolster that authority. As Wittgenstein pointed out before his death, one cannot begin to doubt without being certain, without first believing a set of propositions to be true. In other words, and to pack Wittgenstein's propositions back out into the realm of public health, one cannot have biological uncertainty about a particular virus without first having created a baseline of scientific knowledge about an entire class of influenza viruses.

I have argued here that the creation of a sustained uncertainty regarding the biological properties and characteristics of the H1N1 virus and its strategic deployment merely presupposes the need for the creation of further biological knowledge about the virus. This is how the trick works, and why the admission of uncertainty is no hindrance to the retention of authority in science or in global public health. The new epidemic order shows us that we cannot produce knowledge without uncertainty.

In the next chapter I will look at how uncertainty is dealt with in the realm of information. The daily collection, analysis, and dissemination of information related to the 2009 H1N1 pandemic provided an opportunity for examining how epidemiologists use information to help them sort out uncertainty. Attempts to make sense of the pandemic, to predict the unpredictable, left many working in global public health wondering if there was a better way to cope with missing information and uncertainty that is inherent to all pandemics and to public health response. The issue of information is necessarily raised in close connection with that of uncertainty and unpredictability. To understand uncertainty, then, it is ultimately necessary to understand how public health experts use information to make crucial decisions during a pandemic.

Chapter Five

An Anthropology of Information in Global Public Health: Context, Data Deluge, and the Practice of Making Meaning

Walking down the halls of the national health agency in the fall of 2009, I quickly became recognizable as the 'Berkeley person' doing research on information-sharing and sense-making during infectious disease outbreaks. Two weeks into my tenure, I started being hailed by my academic association and playfully taunted with echoes of my research question: "Hey, Berkeley! Have you figured out the problem of information yet?"

The joke belied the fact that people were often extremely eager to talk with me about the various issues associated with information in public health: gathering data, getting access to various types of data or information, deciphering information in the form of graphs or tables or numbers, generating and recirculating information, and discerning what was often referred to as any 'actionable information' that might be used to help halt the spread of a growing pandemic. Often when I explained the research goals of the interdisciplinary them project of which I was a member, people would let out an audible sigh expressing an 'information fatigue' brought on by dealing with a daily glut of information. The public health professionals I knew well or interviewed – working in the United States and in public health agencies in Hong Kong SAR, China – habitually referred to the steady stream of emails, phone calls, meetings, and teleconferences as part of a 'sea of information' or a veritable 'data deluge.' Already taxed with their regular duties of disease surveillance, prevention efforts, and outbreak response, public health workers everywhere felt that their burdens had increased exponentially throughout the first ten months of the 2009 H1N1 pandemic.

People regularly complained to me about 'drowning' in information, about being bowled over by a never-ending series of 'waves' of data, about having 'barely a drop' of usable information in the oceans that crossed their desks each day. I rapidly discovered that their collective goal wasn't necessarily to become adept swimmers; rather, it seemed to be simply learning to tread water in the midst of a virtual sea of information. The public health professionals I worked alongside or interviewed throughout the year-long pandemic continuously voiced a common longing for a more permanent solution to the problem of *too much information*, for a method or practice or tool that might help them cope with the overflow produced by rapidly improving technological systems of data generation and information-sharing. In 2009, the primary problem was no longer getting access to information, but of effectively coping with an overabundance of it.

Prior experience with outbreaks of infectious diseases such as SARS and Avian Influenza (AI) had led to an increased global awareness of the problems in public health centered on obtaining timely access to accurate information. During the 20009 H1N1 pandemic, I could barely get through an entire conversation without someone directly linking SARS or AI to the present-day problems of information. Post-SARS, it had become apparent to those within the global public health community that information on infectious disease outbreaks of global importance needed to be: 1.) verifiable from a trusted or validated source; 2.) more readily circulated; and 3.) shared at a faster rate. The public health community's subsequent emphasis on fostering greater transparency and

information-sharing in public health, spearheaded by changes to the WHO's system for reporting infectious diseases, including the revision of the International Health Regulations (IHR), solved some of the concerns over access to information, yet at the same time added an increased pressure to more quickly report validated – or correct – information. After 2003, the modern 'myth' that increased transparency and access to more information would produce 'better' information had been born. And yet, over a year after the world's first influenza pandemic in decades, it had become increasingly apparent to everyone working in public health that *more* information was not necessarily *better* information. Instead, the reality of information-sharing during the 2009 H1N1 pandemic had highlighted other, more social – or human – problems tied to the quality of the information being readily shared.

In what follows, I examine how information in global public health networks is produced, managed, understood, and circulated during an outbreak. Using the 2009 H1N1 pandemic as a specific case study for examining the social practice and politics of information-sharing, I argue that informal networks – consisting of personal relationships – were crucial to the process of sharing sensitive, unvalidated, or what people called 'contextual' information. In particular, the recent drive to foster greater efficiency in information sharing has in turn created various technological, scientific, and institutional temptations to decontextualize information in order to share it more quickly. The end result of all this is a problem of quality. In other words, the largely political push toward greater transparency and faster information-sharing in public health has aggravated a need for what the people I worked with often called 'context.'

As a concept used by public health professionals, context refers to details of personal or clinical experience and intuition about a disease outbreak. To them, context is the key to transforming uncertainty into certainty. For me, however, context as a concept refers to the human relationships and daily practices and experiences at the heart of both the production and understanding of epidemiological information. If 'information' is more about the production and circulation of data or facts, then 'context' is more about the production of knowledge and the circulation of experience and beliefs. Without context, 'facts' (or the type of validated information that epidemiologists and scientists traffic in) are still viewed with a certain suspicious as to their soundness or applicability. It is *contextual information* as an alchemic force that helps to turn 'information' into 'knowledge.' Without its attendant context, information produced and circulated during the pandemic was deemed mostly, if not entirely, useless.

Context, then, lies at the very nexus of the human and the technological. It is the dividing point or connecting bridge between 'data' and 'knowledge' as well as the symbol of a chronic lack in the midst of informational overload. As such, context is at the center of my analysis of information during the 2009 pandemic, as I tease out what public health professionals meant by their usage of the word in relationship to information, knowledge, and personal 'beliefs' about the event.

The Problem of Information in the 21st Century

In December 2010, the Oxford English Dictionary (OED) officially revised its entry for *information, n.*, expanding it out into a loose 'definition' that is currently well over 9000 words in total length (2010). As writer and information scholar James Gleick

noted on his blog, appropriately titled *The Information*, the revision of the dictionary entry for information signals not only our obsession with information in the so-called Digital Age, but is also a harbinger of a greater semantic problem (2010). If we want to study information or its effects on the world, then we need to begin with a foundational question: *Just what is information, anyway?*

In this section, I examine the problem of information in public health by attempting to answer a series of interrelated questions: What types of information are regularly circulated, both through formalized public health networks and more informal personalized networks? How do the various people sending and receiving information within any particular network – virologists, epidemiologists, or officials – begin to make sense of the information being circulated at any given time? Finally, what types of information might not be freely shared in formalized communication channels, but remain highly sought after or circulated through 'back channels' or social relationships? In what follows, I analyze what counts as 'good' information by unpacking how people working within global health discuss their experiences with obtaining, interpreting, analyzing, packaging and circulating information.

As the OED revision of the definition of information might suggest, answering any of these questions pithily or decisively poses some significant problems. First of all, the word 'information' itself does not carry the same meaning or indicate precisely the same subject in relationship to time, place, profession, field, or specialty. For someone working in information technology (IT), the term information might refer to bits and bytes of digital information or stored informational capacity. For someone working in public health, however, information might refer to the number of total cases of an illness or information about the standard of care in a particular location. For an anthropologist such as myself, information might be conceptualized as a term related to a set of field data complied of various conversations, statements, beliefs, or how one person is related to another.

Claude Shannon, commonly regarded as the 'father' of information theory, suggested in an early text that a single definition or concept of information was likely to remain elusive (summarized in Floridi 2010). The Mathematical Theory of Communication (MTC), which Shannon created with co-author Warren Weaver, concerns itself instead with the analysis of information. For Shannon and Weaver, the various 'problems' of information could be separated out into three distinct categories: technical (which referred to quantitative aspects of information), semantic (which concerned 'meaning and truth'), and influential (which related to the 'impact' or effect of information on the process of human decision-making) (Floridi, 2).

In common parlance, however, the General Definition of Information (GDI) defines information as "data + meaning" (Floridi 20). Information and knowledge here are seen as intimately related, or rhetorically cast as kin who share a "family resemblance" (Floridi 51). But as Floridi himself suggests, "information is made of data" (20). If this is so, then what we can conceive of as 'knowledge' here is at least partially constructed of collected pieces of information – or aggregated, synthesized, and already-interpreted data. This conceptualization of 'knowledge' is, however, still qualitatively different from that of 'information,' and it is this difference that is at the core of arguments over information-sharing and the call for more context in public health. *Context, or some kind of contextual analysis, seems to be key to the production of*

knowledge from information. The critical question to ask, then, is this: Is the problem of context in relationship to the analysis of information or aggregated data in public health an issue about *the content* of circulating information, *the form* of such information, or *the process* of interpreting that information? The problem of context is focused on the perceived level of transparency about *the process or practice of analyzing information*.

Throughout my fieldwork during the 2009 pandemic, the thing that people most wanted to acquire, what they spent the largest amount of their time trying to gain access to, was not more information about case counts, or symptoms, or even about virulence, but information about how people were aggregating, analyzing, and producing information about the outbreak. In essence, the public health professionals I knew were desperate to better understand their peers' thinking processes. They believed that this type of contextual information would help them to better decide which pieces of generic information – or aggregated data – about the outbreak were most important. In sum, then, they wanted context to help them separate out the important signals from the collective noise.

The Definition of 'Good' Information

In global public health, information is sorted or categorized using a series of complicated rubrics. Naturally, not all information is viewed as being created equal, so public health professionals use a variety of qualities and categories to judge information on a scale from 'good' to 'questionable' to 'bad.' Information is generally considered 'good' when it comes from a known and trusted source, has been scientifically validated (especially in the case of lab results), or has been generated 'in-house' by members of the same national agency. Some of the trusted sources of information inside my were: event reports from ARGUS, a global disease surveillance system run out of Georgetown University; daily reports and outbreak verification lists from the Global Outbreak and Response Network (GOARN); updates from ProMed, a public list-serve system that culls daily news digests for disease outbreak reports and provides open-source analysis of events; and the unit's own private outbreak mailbox (which aggregated data from other sources, both internally and externally). In addition, analysts in my unit regularly received emails with information on outbreaks from their counterparts in other national agencies as well as through their own personal contacts (both domestic and international).

Upon discovery or receipt of information that met the above criteria, analysts generated an internal report on each disease event. The event was then logged into the Event Analysis and Management System (EAMS). In essence, such reports were the product of the aggregation and digestion of other, pre-validated and already circulating information. Such 'information on information' was given an individualized ID number, which functioned like a bar code or an ISBN for each separate disease outbreak; in other words, the same ID number was used throughout an outbreak, much like a bar coding system for disease agents of the same origin. EAMS events were then shared with other national agencies and all outbreaks were carefully monitored, with information on events updated regularly. EAMS was, in essence, a kind of tracking system for international and national outbreaks of infectious diseases of potential concern to the United States. In addition to providing a clearing house for 'good' information and analysis, EAMS ensured that no outbreak went 'missing.'

After a few weeks of tracking all the information traveling into and out of the unit, I tried to begin guessing which information would be deemed 'important' or 'good' and which would need to be further scrutinized or classified as 'unimportant' or as uninteresting. I found that my attempts to play the analyst were usually doomed. Even at the end of my stay, I was no better at predicting which information or events were critical. In the midst of my own daily confusion about what 'good' information looked like, I began to formulate the following questions: How did experienced analysts recognize and prioritize disease threats? What were the specific criteria used to rank the importance of information on an event that had already been categorized as a 'serious risk' to public health?

When I discussed these questions with Robert, the head analyst in my unit, he explained that the team utilized several factors in assessing a disease threat: geographic distribution, ease of transmission, mode of transmission, pathogenesis, reservoirs, and severity. The criteria for assessing severity were the most clear-cut – at least as far as the analysts were concerned. The team "graded" an outbreak threat by its potential mortality and morbidity rates, its potential for causing economic or trade disruption, and how great a potential stress it might place on the local public health infrastructure.

"Sure," I said, still puzzling over how quickly these threat levels were adjudicated. "But how do you know which emails to read? Or to trust?"

Robert went over to his desk, dug around in the folders in one of his filing cabinets, and pulled out a folder. He placed it in front of me and said, "This should help. Let me know if you have any more questions after you read all of this."

I spent the remainder of the afternoon reading the file and ascertaining a basic rubric for deciding which information would be considered 'good' from an analyst's viewpoint. First, any unverified information that filtered into the agency – from any source – would be graded on a scale of credibility, from low to high, using the following formula: credibility of source + validity of information. A high credibility rating would be given to: any information from in-country staff; information that came from an accepted in-country lab; or any information that had been "verified without line list" (which was basically a catch-all category for all information that came in without any doubt about its authenticity). In essence, if a source was generally seen as competent and trustworthy, or had a history of providing valid information, then any information from that known source would automatically be granted credibility. On the other hand, information without *approved* lab support (which usually meant that there was doubt about the authenticity of the information or the trustworthiness and competency of the source) was given a moderate credibility rating. If the source of information had a history of providing valid information *most* of the time, then the information from that source was also given a moderate credibility rating.

Media and internet sources, or any information that came into the unit without in-country confirmation, were always given a low credibility rating. Media sources would only be given credibility if the information reported included in-country confirmation of data from a trusted source. Low credibility was also given to any information *that lacked context*. The quality of information was always partially judged by analysts on the basis of how 'logical' it seemed or how 'consistent with known events' it was perceived to be compared to the analysts own experience with either the disease agent or the location of the outbreak. Context was needed to help the analysts evaluate the consistency of

information from low-credibility sources. Thus, analysts spend most of their time seeking out contextual information to make sense of the hundreds of media or surveillance reports they received on a daily basis. Turning information into 'good' information was time intensive. It required years of experience in order to do quickly and well.

The 'Hierarchy of Resort' in Public Health: Social and Political Aspects of Information-Sharing

During my time with the analysts in the unit, I noticed that ARGUS was the de facto preferred source of 'good' information for event-based surveillance – it even topped reliance on the agency's own open-source and anonymous information-sharing website. The only difference between ARGUS and the agency's site was that the analysts seemed to use their own site frequently when a situation was 'still developing' and uncertainty was rife. Once 'better' information had been received through other, more trusted, channels, events would be officially closed (although the posts would remain searchable as archived events). The site used four categories for posting information: For Your Information (FYI)-Information; FYI-Ground Truth; Request for Information (RFI)-Ground Truth; and RFI-Inquiry. In addition, the listings on the site were prioritized from high to low. There was a shift, or movement, as information was added to an event, from a new outbreak being listed as a 'topic' to a 'reportable event.'

In sum, the site acts as an informal information-gathering and sharing site for information during the earliest stages of an outbreak. Its sources, since anonymous, are never fully 'credible' – yet analysts often visited the site to gather needed 'context,' typically before official or validated information became readily available. As a closed system (only top international epidemiologists are given accounts on the site), the site fills the contextual information gap by allowing people to share unvalidated information along with their best guesswork, early analyses of a situation, and first-hand observations of cases and/or events. It is a conduit for sharing the type of information that public health professionals, especially those working at the highest levels, would not feel comfortable sharing publicly by "going on the record."

Margaret, an analyst in my unit, was the team's point person for Wildfire. She kept up with postings and updated information on current outbreaks listed on the site. As the newest analyst on the team, Margaret was often unavailable to talk one-on-one, so when she offered to take me to a meeting on influenza and then to lunch, I quickly agreed. I was also happy to get a chance to converse alone with the only female analyst then working inside the surveillance unit.

After the flu meeting, we sat down in a quiet corner of the cafeteria. This was not an easy task to accomplish since we were in the 'science' building and scientists, Margaret informed me, were notorious for socializing at lunch. I was surprised to see the cafeteria literally packed with men and women chatting in large groups. The cafeteria in our building, which housed the director and all the top staff, was much quieter with people scattered at large tables eating their lunches alone or in small groups. I hadn't been in a cafeteria as loud since college, and it was hard for me to hear Margaret over the din.

Margaret was in her early 30s with long, blond hair. She was quite attractive and seemed ambitious; I liked her instantly when I met her. She had an advanced degree in

veterinarian medicine, and thus acted as the resident expert on zoonotic disease agents. If she didn't know about an animal disease agent from direct personal experience or knowledge, then she researched it.

When I asked her to explain how she collected information on outbreaks or disease agents, she mentioned that she brought her own personal network of contacts to bear on her job as an analyst. The contacts were from her past – a mixture of work relationships or friendships cemented during her time in school, working at past jobs, or from her time training as an analyst inside the highly competitive Epidemiological Intelligence Service (EIS). She heavily relied upon this group of people for 'good' information or for clarification of any uncertain information that she already had. These people were, Margaret told me, usually not the 'official' contacts that she was supposed to utilize, but it was faster to get information from informal sources whom she knew to be both trustworthy and reliable. Her personal contacts were always her first resort when she needed further information or context added back in to anything she had received through the more generic surveillance networks.

If she could get the 'right' information from her friends and personal contacts, then Margaret expanded her search accordingly. She might still, however, attempt to avoid using what she called 'official sources' or formal contacts. Margaret would first ask Robert or her other colleagues in the unit – or the people that she knew well – for their own personal contacts in the subject area required. Relying upon other people's contacts, Margaret explained, added a layer of difficulty to the task of gathering information. What was a personal contact for Robert was still a stranger to Margaret, and might be hesitant to divulge any 'unofficial' information to her. Yet Margaret still conceptualized using the personal contacts of her own personal contacts as being much easier than extracting information from a more official, formalized source.

What Margaret did, in essence, was tap into the relationships already set up by Robert or her other personal contacts. The trust that Robert had already built up with his own personal contacts was extended – by proxy of Margaret's relationship to Robert – to Margaret herself. The flexible expansion of these personal networks here had the effect of making Robert's contacts feel more comfortable telling Margaret – a relative stranger – something "off the record." From what I observed in my time working inside the analyst unit, the practice of relying upon what I will label here as 'second-order contacts' was an immense help both in procuring contextual information and in forging new relationships and strengthening existing information-sharing networks.

The last resort, Margaret explained, were the official networks for sharing information. Margaret admitted that she would only contact someone from an official Subject-Matter Expert (SME) list if she could not find the information anywhere else. The official level, she explained, was where she found the most 'obstacles' to getting what she needed. People could be tricky at this level of interaction, where the amount of accrued personal trust was so low because the individuals had little or no prior experience working with one another. Social friction, or what members of the analyst team frequently referred to as dealing with 'personality problems,' were viewed as being heightened by formal protocols of information-sharing inside global health networks. In other words, people were stingy with their information – especially if it had not yet been 'verified.'

Essentially, what Margaret described to me is – and here I borrow shamelessly from some of Arthur Kleinman's earliest work – a hierarchy of resort in terms of information gathering. The epidemiologists I worked with had a hierarchy of preferred sources for obtaining 'good' information. Ancillary to the problem of sourcing and access to information was the problem of what I categorize as 'online' or public versus 'offline' or back-channel conversations. Not only did epidemiologists working as analysts in global public health have to spend an inordinate amount of time sourcing, confirming, and assessing information, they also had to repackage information (adding in analysis and context) in order to circulate it back into the information-sharing network or 'loop.' This concept of 'the information loop' was raised many times in my conversations with people about gaining access to 'good' information.

During our lunch, Margaret told me that she was vigilant about having all her email conversations take place 'online' – by which she meant that the other analysts on her team, as well as contacts in other units or within separate public health or governmental agencies, were "kept in the loop" through the diligent use of email 'cc's.' Margaret complained, however, that even when she had cc'd a large list of people, the resulting follow-up replies or enquiries were usually fed back in to her personal inbox – were 'offline' again, basically invisible to the group included on the original email. Because it was seen as vital that all analysts and staff work off of *the same information*, Margaret usually remembered to forward any 'offline' replies to the group email list. However, if things were especially busy or she became distracted by another task, she could forget to do this altogether and then the other analysts might complain that they were 'out of the loop.'

Throughout the 2009 H1N1 pandemic, public health practitioners viewed the problems of 'being in the loop' and what I refer to here as the 'informational hierarchy of resort' as dual obstacles to effective communication and the ability to do their jobs. On the one hand, everyone spoke about 'good' information as though its definition was somehow common or tacit knowledge. In reality, however, different people working in different agencies and in different units all had access to different information – from both a qualitative and quantitative standpoint. Scientists inside microbiology laboratories working on the virus often voiced a variation of the following concern:

> *Listen, we know we have to release information. But at what point do we release it? Normally what happens is we release something once we very quickly do some preliminary analysis, so we're not just sort of releasing unanalyzed, raw data. Because, you know, otherwise other people will analyze it and may draw the wrong conclusion, because they're not actually familiar with the surveillance network or the population, or things like that.*

Another commonly-held opinion about the available circulating information was that it was inadequate to the tasks at hand during the public health response; it lacked the 'context' required to make 'good' decisions.

As someone aptly argued to me, echoing a statement that I heard from nearly everyone I met working on the 2009 H1N1 response: "The data were crap. I mean, that's it. Because it's very, very difficult to gather the data that you need." This powerful and

provocative statement – that the information being circulated transparently and rapidly through the 'official' public health networks was not good enough – was often coupled with the suggestion that there was 'too much' information being produced in the first place. I soon came to believe that what was at stake in these the dirges about a lack of 'good' information was the very definition of information in public health. The 2009 H1N1 pandemic provided people with evidence that advanced technology and information-sharing agreements, which had been set up in the wake of SARS in 2003 to increase transparency and speed up the process of information-sharing, had only fixed half of the problem.

According to scholar Annelise Riles, the act of sharing information is the underpinning of the creation of networks and the foundation of their activities (50). But for Riles, the purpose of all this information sharing is never articulated; information sharing simply *begets more sharing*. Networks are thus tools that create more networks, they are "systems that create themselves" (Riles, 173). Networking then becomes "both a means to an end and an end in itself" (51). Information gathering points such as the U.S. CDC or the WHO become "focal points" in a larger network, and are able to function even if or when those larger networks collapse. Personal relationships are the "underbelly" (Riles, 60) of these formal networks and yet networks produce "an emptiness, a self-critical apprehension of lack" that leads to a desire for more "action" (Riles, 143). Framing information-sharing in global public health from this perspective, we can better understand how the quest *more* information did not solve the problems of information *in toto*. Ironically, the so-called solutions to the problem of obtaining 'good' information – increased transparency and the creation of information-sharing networks – simply highlighted two additional problems: the data deluge and the need for context.

The Data Deluge, or, Too Much of a Good Thing?

On any given 'normal' or 'routine' day, an epidemiologist or analyst working within the framework of global public health can receive upward of 300 emails, text or phone messages. During a severe outbreak of any disease of international importance[26], or during a pandemic such as the 2009 H1N1 influenza, that daily number can reach as high as 500 messages or more. Most public health professionals also attend multiple daily and weekly team meetings – either in person within their own agencies, or in the case of international meetings or meetings across agencies, virtually. This type of frenetic communicational activity is a mechanism for both the production and sharing of the critical epidemiological information deemed so necessary for responding to the threat of any outbreak of infectious disease.

In this section, I examine a few select, but representative, conversations that took place during my observations and interviews in the fall of 2009 and spring of 2010, throughout what was generally referred to as the 'second wave' of the 2009 H1N1 influenza pandemic. The discussions centered around information excerpted and analyzed below focused on the personal experiences of scientists, epidemiologists and officials working inside the highly-charged atmosphere of national public health agencies inside the United States and in Hong Kong. As such, I take them to be demonstrative of the

[26] In 2003, following SARS, the WHO revised its list of reportable infectious diseases and reorganized the categories of disease of international importance or concern. See

problems and practices of public health professionals working under the rubric of 'global public health.' The following examples are thus indicative of a particular type of political-sensitivity. National public health agencies are often the clearinghouses for local, national, and international information about outbreaks. People who work within the confines of a national health policy inside large governmental agencies need to abide by strict protocols of information-sharing amidst their larger efforts to collect enough 'good' information on which to base response recommendations. In examining how public health professionals spoke about information here, I am less attentive to the different types of specific information being discussed (either clinical, laboratory, epidemiological, or contextual data), than I am to the similarities in the narratives of needing to cope with 'too much' information.

I first began to hear about this 'data deluge' while working at the national health agency in the fall of 2009. In the elevator of the building that houses the Emergency Operations Center (EOC), I met a friendly man who was part of a special task force associated with the H1N1 response. After I explained my research, we briefly discussed how people made sense of all the information that they received on any given day. From his own direct experience, he said, there was entirely too much information for individuals to manage. People did their best, but he added that: "It's getting to the point where it's 'information overload', you know? It's hard to deal with everything that is coming at us."

I spent a good deal of my free time discussing what it was like to work inside what is arguably one of the seminal public health institutions in the world. One of the oldest and most experienced analysts in my unit, James, had an extensive, decades-long history in epidemiology. He had been trained under Langmuir as part of the Epidemiological Intelligence Service (EIS) and was a highly-respected member of the team, in no small part due to his wealth of personal knowledge and past experience. When I asked James about his job as an analyst working within global health, he said he had felt completely disoriented when he first started the job. Overwhelmed by the amount of information coming into the group mailbox, he recalled his initial desire to discover what the specific role of a 'global public health' analyst was. Although James had decades of experience, he had been unsettled by the sheer workload and stress of being on the analyst team.

James's colleague, Robert, on the other hand, found the work exhilarating. Robert explained that only 'adrenaline junkies' lasted at any job within epidemiology. Though decades younger than James, Robert had been in the unit since its advent in 2003 and acted as the group's senior analyst. The unit itself had been instituted in the wake of SARS, with the ever-present specter of a SARS-like disease or a deadly bird flu pandemic shrouding the future of public health. The unit had been set up as part of a surveillance and response system. Analysts received information and reports on disease outbreaks from all over the globe, so the team was also an important part of efforts to help coordinate 'global' or international responses to serious disease threats anywhere in the world.

As part of the unit's role in global outbreak response coordination, the analysts sometimes referred to themselves as public health 'diplomats.' The analysts were connected to other internal divisions due to the very nature of their work as aggregators of different threads of information. It was a daily challenge within the unit to provide this

single source of reliable information; the team had to continuously manage a great deal of uncertainty in order to provide leadership with 'actionable information.' From my own brief experience working inside the unit, I knew it was sometimes a very stressful and taxing job – one that did not leave a lot of room for personal 'down time.' As Robert had once explained it to me, one of the benefits of sharing responsibilities within a team was that people could take 'breaks' when they needed them. People often took days off or called in 'sick' in order to recuperate from the 24/7 data deluge.

One afternoon, James raised the issue of the 'data deluge' at the daily team meeting. After complaining about the amount of emails he received per day, James asked Robert if the team might be taken off a surveillance service forward list for new information on H1N1 outbreaks. James wanted, instead, to be able to go to the surveillance service's watchboard to search for relevant information himself.

Robert and the unit's third analyst, Margaret, said that they did not want to be taken off the email list because having emails forwarded to them was easier for them – despite the fact that it increased their daily email load. They both argued that they wanted to be able to quickly forward any important information to people outside the unit as necessary. That task was much easier if the information was already in their inboxes.

I had been working in the unit for only a month and had already noticed that the analysts frequently initiated discussions and had heated debates over information. Typically, the talk centered on how much information was being delivered. In equal amounts, I continuously overheard suggestions and ruminations about how the analysts might better manage all that information or how they might effectively whittle it back down to a more manageable amount. Information was a constant source of conversation. Analysts spent almost as much time talking about information management as they did about the disease outbreaks they were monitoring.

As James listened to his colleague's objections to taking themselves off the surveillance list-serve, he took a cookie out of the jar on the table and said, "Right now it's too much. It interferes with doing good analysis." He argued that they needed to come up with a better method for "sorting out the wheat from the chaff."

As far as I could ascertain from this debate, 'good' information equated – at least for James – to information that had been delivered from someone James recognized or knew personally. He also paid close attention to any internal emails, or to information that he had searched for – and vetted – himself. Everything else was 'suspect' or, worse yet, unusable and clogging his inbox.

Margaret, the youngest and least senior analyst, agreed that all analysts had to cope with a "deluge of emails." Her use of the phrase here was coupled with the suggestion that it was easy to lose track of key information in the surge coming into the unit on a day-to-day basis. All the analysts persistently expressed feelings of being overcome by their email accounts, especially as it concerned the constant stream of disease outbreak alerts from surveillance services like ARGUS. They regularly described the situation as 'being inundated' or 'overloaded' by information. The phrase 'data deluge' was in wide use inside health agency. The feelings the use of the phrase revealed weren't new, however. The 2009 H1N1 pandemic had merely intensified both the situation and the sense of being overwhelmed by information. At the height of the pandemic response, the agency had over 1500 individuals listed as active participants in

response activities. That, by any measure, is a lot of people all sharing and generating information, all needing to be kept in the informational loop.

During a private conversation in the office, Robert explained to me that even in non-pandemic situations, he still received hundreds of emails in a day. I asked him to see how many he had already received that day. He walked over to his workstation, pulled up his inbox on one of his two monitor screens, and laughed out loud.

"It's only noon, and I have 244 mostly-unread emails."

I asked him to break them down for me. Some had been sent directly to him, but most were addressed to the group outbreak mailbox, which fed into all staff inboxes. There were only two kinds of emails that reflected two types of work: passive and active. All the various reports that were automatically fed into his box Robert labeled as 'passive work.' When he or one of the other analysts had to go to a website or get information on an outbreak from someone in their network, that was doing 'active work.'

"The less active work I have to do, the better," he explained. In part, this was because looking for information on sites like ARGUS could take up valuable hours of time better spent doing an analysis of all the information on an outbreak that the team had already received.

A lot of what the unit did, Robert said, was to field questions from people who "can't put things into context for themselves."

When I asked him if he could sum up his main role as an analyst in one sentence, he replied, "People throw balls at us and we just hit them back to people."

The 'balls' Robert was referring to above were all the discrete pieces of information that had to be stitched together and analyzed by the team before they could be "hit back" – or recirculated as more meaningful accretions or 'chunks' of information. What Robert really tried to capture in his reply to my question was this: One of the core reasons for the unit's existence is to give others working in the agency (or its partner agencies) the 'context' they needed to make informed decisions about outbreak response. James, Robert and Margaret re-contextualized all the decontextualized data that was circulated via the various surveillance and information-sharing networks.

From Robert's perspective, there were two reasons for keeping on top of the 'data deluge.' First, the job of an information analyst was to provide an overview of any given situation, to provide what epidemiologists called 'situational awareness.' Second, keeping abreast of all the information allowed public health professionals to better respond to outbreaks. Robert conceptualized the essence of his job as "risk interpretation." The task of locating credible or 'good' information had become much more difficult, however, as the quantity of information had grown.

In many ways, the effect of the 'data deluge' in public health mirrors a similar problem with data in genomics – a bottle-neck effect occurs in any effort to churn out meaningful information from a glut of data constantly being fed into a system. What is required is less information, not more. Or, perhaps more accurately, more selective information.

Risk interpretation, as Robert pointed out, is driven by a knowledge of and interpretation of the 'context' of each outbreak; as such, 'context' is conceptualized as a complex problem. More information has merely served to increase the level of complexity that analysts and others working in global public health have to cope with in

daily practice. The technological capacity to produce and store large amounts information is, as some information scholars have argued, outstripping our human ability to process it.

We are now living in the "zettabyte era" of "exafloods" – or as Luciano Floridi describes it, a "tsunami of bytes that is submerging the world" (6). Information scholar Alex Wright recently wrote that: "Today, we live in an age of exploding access to information, awash in what designer Richard Saul Wurman calls a 'tsunami of data.' Human beings now produce more than five exabytes worth of recorded information per year" (6). Is it any wonder, then, that those working in public health are feeling the strain of this 'flood' of information? The resultant 'data deluge' in public health has led to a kind of communal nostalgia for the past, a time when there were far fewer epidemiologists involved in decision-making processes and response groups were small enough to have intimate knowledge of each other. This nostalgia flourishes, in part, because everyone knows that the 'old' way of doing epidemiology is gone forever. In its wake is a new system of technologies, networks, and hierarchies of information-sharing that all contribute to an ever-growing glut of information.

More data collection and sharing has, in effect, created more and larger information-based networks and greater information-sharing system complexity. Information scholars sometimes refer to this phenomenon as "infoglut" (Floridi 106). What is the real effect of the "infoglut" in global public health on the all-too human networks that form the basis of disease outbreak response? In light of the fact that more information seems to equate to an increased need for more 'error checking,' how much effort is required to turn unverified information into trusted or 'good' information?

To begin to answer these questions, a pertinent example. In the fall of 2009, an outbreak of H1N1 occurred in the Ukraine. At its start, and from the reports trickling out of the country, it seemed as though the virus circulating there might be a mutated strain – possibly a 'new' influenza virus of greater severity. Analysts turned their attention to garnering more information on the outbreak. An excel spreadsheet circulated during the outbreak listed contact information for the response team, and included thirteen people from four different national or international health agencies (WHO-EURO, U.S. CDC, ECDC, RKI/DE). Additionally, five other national or international agencies (including representatives from the UN and UNICEF) were involved at various levels of response – including the country office of the WHO. Added together, there were 85 different names on the email contact list, all of which needed to be directly emailed or contacted with any officials updates and/or epidemiological results. Information on this single outbreak was shared in no fewer than three distinct email clusters, sometimes duplicating information that was already being circulated and thereby adding to the confusion over which information contained 'the latest' information.

This example, by no means unusual, provides evidence of how difficult communication and coordination can be even during a so-called routine response to an outbreak of infectious disease. As one top epidemiologist expressed it, all public health response activity conceals larger issues of information flow. At each level of response, public health professionals have different responsibilities to their local and international partners. As a situation evolves, so does the need to circulate new or different kinds of information.

During the heady first days of the 2009 pandemic, there were calls every day to the states, to clinicians. One top epidemiologist remembered logging 42 calls in a single

day. He reminisced about the initial weeks of the 2009 pandemic and the problem of information flow as both a consumer and a producer of information, arguing that:

> *Some of us were getting less than 4 hours of sleep a night, but we were trying to get info out. On May 7th, we put something out in the New England Journal of Medicine. It's takes time to analyze data, to write. There's this constant demand for information. WHO teleconferencing was limited to Mexico, U.S., U.K., and Canada. But there's a need for this, for sharing information. We need to do more of this – we need to share more epi and clinical information – including the more tropical and sub-tropical countries – to learn from each other.*

By reading through the reports produced during the pandemic, I could see for myself that much of the information being circulated throughout the pandemic seemed to be of a similar nature, if not a regurgitation of the same data, and that different reports were generally organized using similar formats.

Robert, the lead analyst in my unit, explained to me that much of what seemed to me to be blatant duplication of work could not be avoided. Even if tasks were assigned to a single unit within a trusted global public health agency, duplication of work would still occur. This was because, as Robert saw it, different health agencies all had different "bosses." In other words, every public health institution wanted to produce its *own* information, in the possessive sense of the word.

The director of my unit admitted that the system of information-sharing, both within and between public health agencies, did generate more work. He explicated this statement by suggesting that: "The system is designed for information moving up the chain of command, but it doesn't allow for lateral flow or cross-communication." While a hierarchy is a system of groups, organized formally and from the top-down, a network consist of individuals and are organized autonomously from the bottom-up (Wright,7). The trouble is that neither hierarchies nor networks for information-sharing work particularly well in isolation. Rather it is the push and pull between them that is the creative energy behind information-sharing technologies in use in public health today. Networks and hierarchies are not only coterminous, but are "continually giving rise to each other" (Wright, 8). What's more, each has a counterbalancing effect on the other. As Wright notes: "Self-organization overcomes formal organizing's rigidity. Formal organization keep at bay self-organization's tendency to self-destruct" (235). The real effect of all these networks and hierarchies of information is an information overload.

One attendant problem with information overload is the growing tension between a need to be quick versus a need to be correct. People expected responses to be both, the director explained to me, but being correct sometimes required a bit more time – for research, fact-finding, collective discussion, and analysis. I garnered from my own observation of the analyst team that the need to "be correct" often outweighed the need to "be quick." The reputation of the analysts were always seen as being at stake. James, as the oldest and most experienced member, often liked to go into the epidemiological details of an outbreak and compare any current situation with past events. Robert and the director of the team also did this, mining their own experiences for any productive comparisons to a current outbreak. As Robert put it: "In labs, people are used to dealing

solely with confirmed or confirmable data. In intelligence work, people are used to dealing with uncertainty all the time. Analysts are somewhere in the middle."

At a conference held at UC-Berkeley to discuss the 2009 H1N1 pandemic response, a local state public health worker summed up the problem of the data deluge with a metaphor: "There are so many facets of an outbreak, and there's no way to pool everything together. You have your data, they have theirs. It's like the Indian looking at the elephant – you have the trunk, I have the tail."

Her coworker and colleague nodded in agreement and added: "Communication is the key element."

To which the original speaker responded: "You're trying to look at the websites, keep track of the conference calls. Your brain could explode with all the information."

Tellingly, two of the more recent additions to the definition of information in the OED are "information overload" and "information fatigue" (OED 2010). Information fatigue is defined as: "Apathy, indifference, or mental exhaustion arising from exposure to too much information, esp. (in later use) stress induced by the attempt to assimilate excessive amounts of information from the media, the internet, or at work" (OED 2010). Harkening back for just a moment here to the Greek myth with which we began our look at 'global narratives' of influenza, it seems that the giant Argus might be a more appropriate symbol for global public health than we might have hoped. How ironic, then, that ARGUS was the name given to the most prominent surveillance system for disease outbreaks and is often accused of 'overproducing' information.

As Bowker and Star suggested in their study of classification systems: "The rummage sale of information . . . is overwhelming, and we all agree that finding information is much less of a problem than assessing its quality" (7). Information systems are designed in part, suggest Bowker and Star, not only to store experiences but to connect "experience gained in one time and place with that gained in another, via representations of some sort" (290). This type of 'context' necessarily shifts due to the continual need for encoding and decoding of information to allow for its easy transmission. For Bowker and Star, "information *must* reside in more than one context" (290) for it to be perceived as information at all. To be understood, these different contexts must be "relinked through some sort of judgment" (291). It is this linkage that the analysts I work with performed on a daily basis.

Yet, as Bowker and Star have also argued, "information is only information when there are *multiple* interpretations" and that "it is the tension between contexts that actually creates representation" (291). In essence, then, there is a permanent tension between the creation of information systems and the increased need for context, between individual and collective interpretation of disease outbreaks and events. It is this friction between information, context, and the production of meaning during the 2009 H1N1 pandemic to which I turn next.

Interpretation, the Production of Meaning, and the Exchange Value of 'Context'

There's a thin line between how much you need to know and what you want to know.
- An epidemiologist on the ever-present need for information, July 2009

While working with epidemiologists and virologists, I often had the distinct impression that they were expressing a desire for something called "perfect information" (Floridi 98). Perfect information is a term used primarily in game theory to indicate a situation or 'game' in which *all* the players have *all* the fundamental information they need to make accurate decisions. Clearly, in the daily practice of epidemiologists and analysts, a 'player' was almost always playing the 'game' of public health with incomplete information.

As information scholar Luciano Floridi explains it, in any given situation where there is only imperfect information available, "there is a general need to be able to gain as much as possible of the missing information – either about the players (types, strategies, or payoffs) or the history of the game - by 'retrodicting' (predicting backwards) from the information that one does hold, the information that one misses" (99). Borrowing from Floridi, I suggest there are three distinct ways of thinking about information in public health: *as* reality, *for* reality, and *about* reality (74). Going further, I argue that 'context' in global public health concerns a perceived need to solve the problem of imperfect or incomplete information *about* the reality of an infectious disease outbreak. Context was about interpretation as much as it was about 'facts on the ground.' People expressed a desire for context in order to 'complete' the informational picture about an infectious disease event. In other words, context produced knowledge from incomplete information; it helped to create meaning and thus had a very high 'exchange value' among public health professionals.

Anthropologist and science studies scholar Stefan Helmreich has argued that "meaning does not preexist interpretation; rather, the readjustment of context is that which *makes* meaning" (57). Taken from this view, 'context' is not ancillary to the 'information' that it is attached to, but is "woven together" in "a weaving that happens contingently, not deterministically" (Helmreich, 169). For Helmreich, then, context "appears as the Jameser of relevant relations" (235); it is about what information *does* in a particular setting or environment, not necessarily about what it *is*. Context, then, helps us to better see how information is interpreted, how experience and events are woven together to create knowledge about events, and how those using information relate to one another. It is this social view of information that I will take as my departure point for examining 'context' in public health during the 2009 H1N1 pandemic.

1. The Case of the Missing 'Context'

Near the beginning of the second wave of the pandemic, I attended an International Flu Team meeting on H1N1 with Margaret, the junior analyst from my unit. The meeting started with a slide show of graphs analyzing various data that had recently become available. Most of the data had been circulated in the latest WHO report.

Frank, the team's leader, announced at the start they were going to try to start amalgamating information in one location. He told the attendees that: "We need to try to consolidate all the bits and pieces flying about by email." Almost all attending nodded. Some smiled and glanced at each other, as if in silent commiseration about the need to reduce the information glut.

The meeting took place as a conference call and lasted about an hour, including a "listen only" period when the director was the only one allowed to speak. Frank, the

director of the international team, began with an update on the situation in the United States. He seemed to offer the information up as an initial gesture, similar to an opening gift in a modern-day kula ring, an exchange based on epidemiological data instead of shell necklaces. He then gave his personal opinion, based on the data he had just reported, that: "This will be a bad season, but we knew this already."

Frank then gave stats on lung infections in ERs (7% of cases), noting that the fall flu season was in "full swing." After the director stopped speaking, five people on the conference call gave field reports from regional offices around the world. All were very short in length and scant in data. There was little new to report, and no new activity, since the last call.

After the conference call ended, Frank questioned those in the room about the utility of continuing weekly conference calls or meetings at all. "Would it be alright if they shifted from now on to every other week?" he asked. Most nodded their heads.

While the calls were clearly crucial to the collaborative process of exchanging information and producing meaning, there was an obvious disconnect between what was shared on and off the conference calls, or "on and off the record." While it was true that quite a bit of information was readily shared, not many decisions were made on conference calls. It was a paradox since the calls were seen as vital to epidemiological sensemaking, but were viewed with a mixture of duty, derision, and apathy by many of the participants. Increasingly, people saw the daily barrage of meetings and conference calls as a waste of their time; they lamented that after months of pandemic response, nothing new was being shared. The real information, the analysts told me, or 'context,' was something one could only get by calling or emailing someone directly and 'off the record.'

In an email later that same day, I received official minutes of the meeting. The email itself provided me with evidence of how people interpreted what they heard, as well as the confusion that might sometimes result from being exposed to different interpretations of the same information. The minutes clearly stated that the upcoming flu season would be a bad one, exactly as Frank had opined at the meeting. And yet, something felt missing to me – a piece of 'context' had dropped out.

Checking my field notes, what Frank had actually said was: "It's going to be a bad season, but we knew this already." How might the elision of the contextual phrase "but we knew this already" alter the meaning of a seemingly objective piece of information about the fall flu season? I suggest that the erasure of Frank's ancillary "but we knew this already" makes the official statement about the flu season sound more dire than it would have if the reader had been able to access the second half of Frank's statement regarding severity. Without the phrase "but we already knew this," we don't know that his statement actually reflects nothing new. There have been no new interpretations, new information, or any developments of real significance. The phrase "but we knew this already" is thus a key piece of contextual information. It indicates that Frank's thinking about the severity of the upcoming pandemic was more in line with the decreased level of response activity that I had observed during that week.

In this example, the term 'context' is synonymous with 'interpretation.' What was lost in communication was Frank's interpretation of the WHO's information. Without the second part of the statement, or the contextual information, the information about the severity of the upcoming flu season caused a good deal of confusion among those not in

attendance at the meeting. The call for more context can thus be read as an attempt to alleviate some of the uncertainty surrounding the course and severity of the pandemic.

2. The Exchange of Context as Relationship-Building

Uncertainty or doubt about the quality or contents of epidemiological information on the 2009 H1N1 pandemic were typically dealt with via email exchange of pieces of discrete information or the sharing of personal opinions and context about already circulating data. In official communications, all indicators of doubt or uncertainty were largely removed from written reports. But in more informal communications, public health professionals had more freedom to express doubt or to ask for clarification about unverified information. These exchanges were most often completed through emails or on smaller conference calls. Not infrequently, however, someone would get frustrated by an inability to explain something adequately in written form and would make an effort to speak directly with a trusted peer – either face-to-face or by calling them on a private telephone call.

The exchange of bits of 'context' in an effort to 'clear up' uncertain situations, events, or information was part of the analysts' daily routine. The need to fill in gaps in information instigated a great variety of such 'context' exchanges between individuals and groups in an effort to understand other information that circulated during the 2009 pandemic. After receiving an email containing lab reports, case counts, or other various epidemiological information, analysts would often contact their colleagues for clarifications or to request the latest updates. In addition to this, the analyst unit received many emails, visits, and phones calls for the same purpose and spend a good proportion of their time responding to such enquiries from people working in other divisions.

In addition to adding 'context' back into the information, these communications during times of uncertainty were often an integral part of basic relationship-building. The practice of initiating and answering emails and telephone calls helped to strengthen the bonds between individuals who were already familiar with each other and aiding in the development of trust between relative strangers. Emails and telephone calls were frequently seen as overtures toward the further development of personal contacts between units or agencies; the analysts would often contact someone for clarification simply to bolster a weak relationship between their team and another division. This type of act was referred to as part of the analyst's job of 'staying connected' or 'in the loop.'

This kind of regular exchange of contextual information had real operational and pragmatic value within the global health system. Strong ties between individuals and groups meant better access to uncertain information and faster response times. In other words, the more robust the personal connections between individual public health professionals, the more quickly future official requests for information would be heeded.

3. Context, 'Politics,' and 'Public Health Diplomacy'

There were instances when it was necessary to provide context in order to smooth over hurt feelings caused by minor disputes over jurisdiction. The analysts in my unit were used to fielding a variety of questions and had learned to be sensitive and diplomatic in their responses. Often it was the analysts that initiated requests for further information, but they also attempted to strengthen their contacts and expand their

personal networks by forwarding unasked-for contextual information or analyses to those working in different units or national agencies. They often used their tacit knowledge of the intricacies of the global health system to guess who might not have seen or been privy to the vast array of non-public information. Preempting requests for new disease reports or new lab data was an easy way to make those working outside of the agency – especially in other countries – feel less excluded. As a gesture of good faith, this seemingly 'open' and free exchange of new information was, to put it frankly, good for future 'business.'

While working inside the analyst unit, I had often felt disenfranchised myself. Most of what I was given ready access to was surveillance data; I was never privy to the private emails or conversations that occurred in the side communications of the analysts. Whenever people discussed information contained in emails that I hadn't received, I wondered if the omission had been intentional and whether or not the team really trusted me. Questioning the team's trust in me would make me question my own 'good faith' in them. My own issues centering on access to information, then, is just one pertinent example of the real emotional effects of feeling in or out of 'the loop.'

My own experience was not anomalous to the experts I worked alongside. I, too, was continuously looking for context in order to make sense of the information I already had. The difference, of course, was that the analysts were highly cognizant of the 'chain of command' when communicating with each other, other internal and external divisions, and staff in other countries or national public health institutions. I quickly became interested in mastering the protocols and practices that might allow me to gain access to better information or context myself. To learn more about 'context,' I began to pay more attention to the moments when information flow showed signs of break-down or frisson between the various 'players.' Context was often used during these 'incidents' to smooth over any social or political friction.

4. To Add in or to Not Add in Context? The Case of Context as Expertise

While working on the H1N1 update, James, the senior analyst and the team's point person for writing reports on the pandemic, grumbled that he had to be too circumspect in the information that he officially circulated. Because he was the main person who wrote the updates, he felt personally responsible for their content. On this particular occasion, the WHO had just released a report on H1N1 in Asia. But James could not verify everything in the official report – so he was nervous about reporting on it at all.

"We're in the business of putting the pieces together. This is the business of risk assessment," Robert said, in quick response to James's question about what to include in the official report. "We add value by putting things that are speculative into the report."

The problem of interpretation of WHO data was at the core of the dispute over the report's wording. The influenza division, as lab scientists, did not want any 'speculation' in the report. Public health professionals who were not familiar with surveillance methods or analysis, but worked in response or in laboratories, often did not like to circulate anything but verified information, or what they called 'hard data.' They were not comfortable including guesswork or interpretation – despite the fact that such 'context' was deemed by others as necessary to the process of turning information into usable knowledge about a disease outbreak. The debate over 'context' here reflects an

ever-present tension between a need to wait for 'good' information and a need to 'best guess' in order to effect response actions. There was thus an endless quest to put available hard data back into more 'context' in order to make faster decisions.

In the end, the paragraph stayed in. James and Robert were successful in their use of context to bolster expertise.

5. Context as Past Experience

One way analysts working in my unit conceptualized the present and tried to anticipate the immediate future was by using their past experiences as a lens to view unfolding events. Every outbreak or piece of information was either overtly or subconsciously linked to something in the past. Sometimes the 'past' literally denoted an official historical record of a past event, but most often it referred to what I call the subjective 'experiential rolodex' of respected epidemiologists, scientists, and other experts working in public health. The analysts in my unit often paused in their daily meetings to quietly think to themselves for a moment; then they attempted to connect any recollected personal knowledge about similar past events to information about a current outbreak. This type of past-as-context referencing was prevalent during the very beginning of a new outbreak, especially those where the disease agent was still unknown.

In a paradigmatic conversation about a disease outbreak in Country H[27], Robert discussed what he remembered from a similar event that took place in Country R in 2001. This was Robert's attempt to begin to understand – or formulate an opinion about – what was then currently happening in Country H. The past event in Country R provided some insight into how the response team might deal with the event in Country H. However, the comparison – an effort to apply past-referencing context to a new situation – also seemed to constrict the team's choice of response actions. The fact that the disease agent was known to affect children, was not fatal, and was still of unknown etiology made Robert more hesitant to send assistance to Country H. He was immediately cautious about extending aid to a response project that might last for months (as it had done in Country R), especially if the disease outbreak wasn't an 'international' threat (or likely to spread beyond the borders of Country H). Here the past provided an analytical basis for both thinking about an outbreak in the present tense and for deciding a course of action to take in the immediate future.

The past as context was a prevalent tool used by analysts and epidemiologists to 'make sense' of current events. Indeed, Robert had explicitly argued that: "Building a large database of past cases is important." He explained to me that deciding what should be viewed as a 'serious risk' was an art, not a science. It was based almost entirely on contextual information. At a training conference I attended, Robert explained to the attendees that the job of an analyst in global public health was to understand 'context.' He suggested that:

> *One media report is enough to be concerned, but we look at things contextually. You can't possibly investigate everything – it's a waste of resources. It's like "crying wolf." There's no magic number of cases that signals a response – it's context-specific.*

[27] For security purposes, and to protect the integrity of those I worked with, all country names, specific locations, and individual names throughout this text have been omitted.

Because ‘context’ here is the product of a personal, time-intensive, lived experience with disease outbreaks, an easy technological fix to the general problem of gathering such contextual information was hard to find.

6. Context as Value

The more time I spent with the analysts, the less confident I was that there would be any such easy ‘solutions’ to the problems of ‘real-time’ information-sharing or collective sensemaking. It almost seemed as if the individual users of information were destined to have interpret information alone or within small, personalized groups. It was unimaginable how efforts to ‘capture context’ – an idea which had valence almost everywhere I went – would be successful. The director of our unit thought that setting up a Wiki – an online site where everyone would be able to keep track of past outbreaks and contacts – might help with the problem of sharing contextual information.

As the youngest analyst, Margaret expressed her doubt that this would work in practice, telling me that: “Everyone sees a Wiki as the holy grail.” Then she laughed and explained that everyone wanted to solve all the problems in global public health by making what was inside one person’s head visible to everyone else – instantaneously. Margaret argued that people wouldn’t necessarily use a Wiki. At best, it might be a place to log past events for reference – which would, she admitted, be an immense help in the task of analyzing future events more efficiently. It might also provide analysts with an open source of group knowledge, thereby making everyone feel more ‘in the loop.’ But Margaret also worried that a Wiki-style web site for sharing ‘context’ would not be able to capture all the tacit knowledge or ‘gut instincts’ of its members. What’s more, she argued that a Wiki could never capture individual thought processes, which were the best source of ‘good’ information. Context here is not about the form or content of information, but about the process of producing that information.

Others I spoke to were equally emphatic that ‘good’ information included personal assessments or ‘gut feelings’ regarding so-called hard data. As an epidemiologist working at the WHO suggested during a Berkeley conference on H1N1: “It’s not just the hard data, it’s the feeling that goes along with it as well. We can communicate the information well, but I’m not sure we can communicate the feeling that goes along with it.”

One of her peers at the WHO nodded in agreement, adding: “There’s a fair amount of experience in this room, but it’s a question of how our gut feelings are translated into information.”

A representative from a local California public health agency summed up the problem thus: “It’s all personality driven. It all comes back to trust.”

The director of my unit, also in attendance at the Berkeley conference, argued that all information-sharing networks required a certain level of trust in order to function at all, stating that: “You really have to know who the players are, you really have to know who the organizations are. We were using the term ‘social networking’ years ago when we were trying to set up networks to get information.”

Another top influenza expert added: “Lots of information is not posted anywhere. It’s one-to-one, based on trust. I’ve worked with someone closely in the field and I’ll call them up to see what they know or to tell them about what I know.”

Some of the public health professionals involved in the 2009 H1N1 pandemic response seemed outwardly dubious, if not somewhat hostile, about the possibility of sharing such 'gut-level' interpretation more formally or publicly. Context, one epidemiologist argued, "is going to be very hard to capture." There were several reasons that experts were unwilling to share openly what they were willing to share privately. Sharing certain types of 'sensitive' information might get someone in trouble. It was always a personal judgment call, one analyst told me, about "what you share and what you don't." A prominent epidemiologist that I interviewed likened the sharing of context to office gossip, and argued that:

> *You can sign all kinds of memorandums, but you don't know the guy, and he's not going to tell you anything. . . .It's just like an office. It doesn't happen in a room, but at the water cooler, in the toilet. [laughs] At the snack bar. During coffee. I think that's a very important point. In these past few years, we've tried very hard to establish good relationships. And trust. So if there's something fishy going on, people are going to tell us.*

Another epidemiologist echoed this sentiment and equated the sharing of information in global public health to a gift exchange. He suggested that: "The response will be quite different for the person coming in with a 'dowry' and those without. If you call me up and say 'You have anything for me?' the answer is no. But if you come to me with some information, then the response will be very different. Coming in with a 'dowry' will really affect the exchange."

The idea, expressed above, that 'good' information or context had an obvious exchange value was echoed many times during conversations with public health professionals regarding their information-sharing practices. Credibility and trust are important attributes of individuals that transfer to the information they share directly. The regular exchange of 'context' as part of 'good' information strengthens that same trust and credibility over time. As 'gifts,' these pieces of information and context are "not freely given" and "also not really disinterested" (Mauss, 73). Rather, these informal information-sharing circuits form the basis for the more formal information-sharing systems being set in place by the WHO. The sharing of information informally, and especially contextual information, is the foundation for almost all communication. Without these exchanges, communication and sensemaking in global public health would be ineffective at best, and grind to a halt at worst.

Conclusion: The Anthropology of Information and Information-Sharing Systems

The problem of defining 'good' information, the 'data deluge,' and examples of the role of context above should be read together as an ethnography of the daily practice of turning information into actionable knowledge within epidemiology. They also highlight the various problems of attempts to gather, analyze, and report information on H1N1 throughout the 2009 pandemic. But perhaps most importantly, these examples are indicative of the messy and complex process of making sense out of a daily 'deluge' of information.

To deal with the increasing volume of data and information, health organizations utilize a set of criteria for determining 'good' information and have developed a protocol for information-sharing. Yet the epidemiologists who work within large public health institutions or agencies still have to individually 'make sense' of each unique situation by using that set of criteria *as a guideline*. In order for certain response actions or decisions to take place, epidemiologists must rely upon each other's analyses and personal judgments. Information-sharing and the use of context captured from my fieldwork and described above suggests to me that information in global public health moves through the following informational stages:

1. *gathering information*, or aggregating data from unofficial, surveillance, or informal sources
2. *searching for and understanding context*, or analyzing all previously aggregated information in light of personal opinions, unvalidated information, or contextual details of disease outbreaks
3. *producing, (re)circulating, and using 'good' information* to affect official response actions or recommendations for local action.

While information on an outbreak might 'look' exactly the same, the contextual information produced by people who interpret that information will necessarily be different. In other words, *different conclusions will be based on the same information*. This difference is qualitative and due to the common daily practice of producing contextual information that is itself based on the unique lived experiences of individuals working in public health. It is this type of *past lived experience as context* that global public health information systems have trouble sharing through any formal channels. The multitude of teleconferences, meetings, emails and personal telephone calls which I observed throughout my fieldwork were attempts to gather such experiences as context – all in a concerted, if misplaced, effort to qualify and quantify what it was difficult for many individuals to describe, little alone to capture in an email or standardized form.

Scholars working on topics and issues associated with the development of formal information systems have coined a name for humans living in the so-called Information Age – inforgs. Inforgs are loosely defined as "interconnected informational organisms" that consist of both "biological agents and engineered artefacts" that live in a world "ultimately made of information, the infosphere" (Floridi 9). Floridi sees this transformation from human to inforg as something that is fundamentally "re-ontologizing" what it means to be human and to live in the 21st century.

I find both Floridi's argument and the concept of inforgs compelling, even if I also find myself pushing against such a too-easy neologism. As inforgs, public health professional have only a tenuous self-knowledge or self-reflexivity about how they are imbricated in all the technological devices and webs that spin around them in the 21st century. Their daily practices of checking emails, looking for the latest news online, and of livestreaming meetings are merely a few common examples of the practice of epidemiology in the infosphere.

The 'life cycle' of information has four phases: the occurrence, production, or discovery of information; the transmission or communication of information; the processing and management of information; and the usage of information (Floridi 4).

While many studies have paid attention to how various experts, such as the analysts discussed here, gather and consume information, little attention has been paid to the human/technology interface that produces such information in the first place. One solution might be to take the use of information and information technologies more seriously from an anthropological viewpoint. Such an 'anthropology of information' would need to pay particular attention to points where the human and the technological become enmeshed with each other. As Bowker and Star have argued, there is "a permanent tension between universal standardization" of information-sharing systems and "the local circumstances of those using them" (139). Efforts at further standardization of information systems in global public health are only doomed to worsen the problem if they fail to take the problem of context more seriously. And context can only be understood at the level of the social and the cultural – or the realm of anthropology.

EPILOGUE

This dissertation, in many ways, is itself an unfinished narrative. Initially conceived as an examination of the myth of a killer avian influenza pandemic, it ended up as an analysis of the very-real events that unfolded near the start of my fieldwork in 2009. What started *in media res* must end there, too. How could there be an end to the story of a pandemic, especially one so recent in linear history that its narratives are constantly being rewritten, reshaped, and retold?

There is no one 'story' of the 2009 H1N1 influenza pandemic. Rather, the various accounts of the events that took place in 2009 – including this one – are part of a much larger narrative about influenza and about pandemics themselves. As such, pathography here has been an attempt to gather as many of those tales together as possible in order to recreate a three-dimensional 'picture' of what a pandemic is, about what influenza and information about influenza 'does,' and about what it means to be an expert producing knowledge within global public health.

Ultimately, pathography as a type of '-graphy' is about writing a pathology or an illness from a 'god's eye' point of view. It is an attempt to combine ethnography – necessarily a partial, perspectival, ground-level narrative of events – with something else, something more 'meta.' Pathography, then, utilizes a grab bag of techniques and tools to accomplish its goals. Someone writing a pathography is not limited to the use of participant observations; rather, a pathography is an attempt to inscribe the methods and insights gained from ethnography onto other methods of writing about an event or a thing in the world. Pathography is thus always part historiography, part political-economic analysis, part ethnography, part scientific understanding, and part creative non-fiction. It is a 'partial' attempt to do everything, to write everything, and yet also an effort to leave enough room for the reader's own interpretation and examination and questioning. Pathography is not about offering up definitive answers or solutions, but about an attempt to ask the right questions about globe-spanning events and phenomenon.

Like Thomas Jefferson's library, this dissertation is separated into parts, roughly corresponding to Bacon's separation of the sciences into: history/memory, philosophy/reason, and fine arts/imagination. Though make no mistake; unlike Bacon or Jefferson, I do not assign any hierarchy to my classification system. I have taken Lampland and Star's suggestion "to continually interrogate the imbrication of theory and evidence without being forced to choose the strictures of linearity, create simplifying models, or forgo the dynamics of history" (Lampland and Star, 208). In other words, and to echo one of the 'pioneers' of information technology, sociologist Ted Nelson, everything here is 'intertwingled.'

The initial chapters of this dissertation on biological origin stories began as an attempt to build on Latour and Woolgar's *Laboratory Life*, to do an ethnography of the 'everyday' of scientific activities *throughout* a 'historic event.' It was – and remains – my position that focusing either on 'events' or on the 'everyday' creates a false dichotomy. The everyday of the microbiology lab or the public health institution are folded into a year-long pandemic; the boundaries between the everyday and the event blur to the point of abstraction.

Both the first and the second half of the dissertation work "athwart theory" (Helmreich, 23). I move 'sideways' through a bevy of disciplines and techniques to

construct a meta-narrative, of sorts, out of pieces of the whole, all the while knowing that the pieces cannot really be pieced back into a whole. I followed both 'material' and 'information' flows and the networks that were involved in exchanging both information and virus samples. In doing so, I unearthed larger questions: What are the real differences – if any – between material and information flows? What work does material do that information – as divorced from its material contexts – cannot, or vice versa?

As Annelise Riles has argued, the adage that "more information is better than less" is a grounding assumption of modernity. And yet, as Riles also suggests, "information does not in itself merit ethnographic attention; what matters, rather, is how it flows and what social consequences follow" (93). In this formulation, information is always in excess or scarcity. We either have too little or too much information, but never "just enough." Susan Leigh Star and Martha Lampland noted in *Standards and Their Stories* that infrastructures – such as the information-sharing systems I analyze here – are not easy things to pin down nor to study. For one, they argue, infrastructures are often the most 'boring' parts of our world; as such, they are often invisible or unthought-of parts of our daily lives (Star and Lampland, 17). Most importantly, however, Star and Lampland's edited volume on "boring things" illuminates just how "fundamentally relational" infrastructures really are (17). Thus, knowledge for knowledge's sake – or the German idealist concept of knowledge born out of the Enlightenment's association of knowledge with freedom or emancipation – succumbs to a new type of knowledge that is produced for pragmatic purposes, or knowledge for practical application and use.

In *The Post-Modern Condition*, Jean-Francois Lyotard wrote that in the 'post-modern' era: "Knowledge is and will be produced in order to be sold, it is and will be consumed in order to be valorized in a new production: in both cases, the goal is exchange. Knowledge ceases to be an end in itself, it loses its 'use-value'" (4-5). This new regime of information production and exchange, however, relies upon new information technology. It is information, and not knowledge per se, that reigns supreme here.

It is important to note here that for Lyotard, knowledge is not science. Rather science is "a subset of learning" (18). Generic or 'narrative' knowledge can be prescriptive, denotative, or evaluative. Scientific knowledge is only denotative. Narrative legitimizes itself; science, with its reliance on falsification, cannot legitimize itself or any other game. Thus, the crisis of legitimation in science is produced by science itself. And here is the fundamental problem with that: "Scientific knowledge cannot know and make known that it is the true knowledge without resorting to the other, narrative kind of knowledge, which from its point of view is no knowledge at all" (29). Knowledge – at least under the German system – finds legitimacy within itself, but not validity (34-35). Validity must come from another source, from humanity itself. Knowledge, for Lyotard, has transformed from a subject itself into something in service of a subject (36).

However, the problem of knowledge production within global public health is that information has approached the limits of its quantification – which can be seen in the increase in calls for more contextualized, or qualitative, information. But this type of contextual information does not circulate well in the information age, partially because it does not translate well. If information is about validated science, then context is about 'storytelling' or the stored knowledge and personal lived experiences of scientists and experts working in public health.

As Frederic Jameson noted in the preface to *The Postmodern Condition*, Lyotard himself examines "the relative retreat of the claims of narrative or storytelling knowledge in the face of those of the abstract, denotative, or logical and cognitive procedures generally associated with science or positivism" (xi). Jameson tells us that the main question that Lyotard poses is thus: "How to do without narrative by means of narrative itself?" (xix). Lyotard's subject, like Foucault's, is the creation of power through the creation of knowledge. For Lyotard, in a technological society like our own, access to information is power. And science's ultimate job is not to produce the known, but to produce what is unknown. Lyotard argues that: "It is changing the meaning of the work knowledge, while expressing how such a change can take place. It is producing not the known, but the unknown" (60). What Lyotard is ultimately arguing here is that the legitimation of science is now produced through what he terms paraology – or a movement against an established way of reasoning (60-67).

Similar to Kuhn's work on paradigm shifts, Lyotard's paraology suggests that an adept "move" in the game of science is to combine new threads of old arguments, to move against established theory, always pressing outward or against the grain. As Lyotard suggests: "Invention is always born of dissention. Postmodern knowledge is not simply a tool of the authorities; it refines our sensitivity to differences and reinforces our ability to tolerate the incommensurable. Its principle is not the expert's homology, but the inventor's paraology" (xxv). Thus, it is more important under this rubric to ask questions than to produce answers. It is to that end that the concept of pathography here leads.

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The outbreak narrative fuses the transformative force of myth with the authority of science.

- Catherine Wald

His predicament – being weak and knowing it – points to the need for a theory of imperfect rationality.

- Jon Elster on Ulysses and Greek sirens

Using the myth of Ulysses and the sirens to talk about rational choice theory, scholar Jon Elster argues that: "Societies as well as individuals have found it useful to bind themselves" (37). Binding is an example of someone "precommitting themselves" (Elster, 37) to a certain course of action. By binding themselves, in this case through the use of H5N1 pandemic planning, global public health experts thereby committed themselves to a very specific course of action during the 2009 pandemic. In essence, such acts of "investment" are often irreversible and commit the individuals to a pre-ordained course of action that may cost them in the future (42).

When the pandemic alarm was sounded in March of 2009, there was only one course of action for most public health experts to follow. Pre-bound by pandemic plans set out by the WHO and agreed upon by all member nations, public health institutions everywhere responded to the mild H1N1 pandemic *as if* it were H5N1. Once the emergency switch had been thrown, it was difficult – if not impossible – to change

course. Actions set in motion by pandemic flu plans were carried out long after public health experts realized that the threat from H1N1 was relatively small.

I do not mean to suggest that pandemic planning itself was irresponsible or ineffective. As Elster suggests: "The Ulysses strategy is a precaution against inconsistency, not against irrationality; in fact it achieves consistency at the cost of an even larger departure from rationality" (73). The choice to bind oneself ultimately depends on the value being placed on consistency over rationality (Ester, 76). Borrowing from Elster, then, I suggest that the price of consistency in response action may have been too high during the 2009 H1N1 pandemic.

Thus I end this dissertation with a return to the myth of the Greek sirens, arguing that the public health community's focus on H5N1 – or avian influenza – spurred the development of new technology and better surveillance for influenza and other infectious diesases, but steered the ship of public health too far off course from an 'all-hazards' approach to preparedness. Worrying about H5 and its cousin avian viruses ultimately created a global public health 'blind spot' when it came to other strains of influenza. Planning for H5N1 created more work for epidemiologists and virologists, but did not necessarily lead to better disease surveillance or preparedness. The glut of information that such surveillance systems produce does not necessarily lead to a greater knowledge.

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