Why the Net Matters

Six Easy Ways to Avert the Collapse of Civilization

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PREFACE

Why Do Civilisations Collapse?

Congratulations on living at a fortuitous moment in history. We enjoy a stable society that brags technology, progress and opportunity. It proves difficult to imagine that all this – our governments, our culture, our storytelling, our creations – could fold up and collapse. How could our lofty glass-and-steel edifices fall into ruin? How could our proud national story shrink to a few lines in history texts of the future? How could our venerated deities go the way of Neptune and Kukulcan and Osiris? How could our culture degrade to the unremembered?

Note that you would have had exactly the same trouble envisioning collapse if you lived in the brawny empire of the Romans, or during the Golden Age of the Athenians, or during the pinnacle centuries of the Egyptians, the African Mali, the Babylonians, the Mesopotamians, the Toltec, the Anasazi, or any of the other societies that have risen and fallen before us.

In the surprisingly short span of written history, an astounding number of great civilizations have collapsed. Centuries of progress and development have caved in on themselves, leaving nothing but archeological ruins and scattered genetics. Sensitive literature, inspired mathematics, and bold architecture have degraded in the compost piles of history.

But why? The mystery of disappearing nations has always attracted researchers to sift through the evidence to discern what went wrong. Happily, their detective work has paid off. Patterns have emerged. Although there are many vanished civilizations, they share in common a handful of maladies. Foremost are epidemics, natural disasters, poor information flow, political corruption, economic meltdown and resource depletion.

These are problems that almost all civilizations come face to face with – in some degree, in some fashion – at some point. And so will we. Repeatedly.

But I make the case in this book that we may be luckier than most of our predecessors. Almost accidentally, we have developed a technology no one else possessed: a rapid, growing communication

network that finds its highest expression in the internet.

I will attempt to demonstrate that this technology obviates many of the threats faced by our ancestors. I will argue that our largest threats may already be counterbalanced by our most popular and beloved technology.

From tsunami warning systems to Twitter revolutions, from the conversion of commerce into zeros and ones to automated epidemic detection, from information immortality to the democratization of education, the net is changing the rules of the survival game. This is not to say there won't be new threats, or the need for constant vigilance, or that my cyberoptimistic arguments are not nuanced by the double-edged complexities of technology – but it is to say that our risk analysis is undergoing a full overhaul. We are poised in a watershed moment in history. One in which all the equations are changing.

We all enjoy the net for its fast lookups, social pinballing, online bargain discovery, and instant knowledge gratification. But the roots of its importance run deeper. And they require careful attention. After all, the nervous system of the net has wrapped our planet like kudzu, working its way into lives, buildings, economics and societies. What better opportunity is there for naturalists of the early twenty-first century than to study, probe and seek to understand this new creature?

I believe this study will appeal to both utopians and pessimists. In the following chapters we will widen our lens to take in the entire globe, and lengthen our timescales to think about millennia. By doing so, one point will come into clear focus: the net matters.

CHAPTER ONE

Sidestepping Epidemics

One of our more dire threats for the collapse of civilization comes in the tiny package of infectious disease. Microbial epidemics precipitated the fall of the Golden Age of Athens, the Roman Empire and most of the empires of the Native Americans.

It's a bitter irony that the largest threat to civilizations is something invisibly small. So small, in fact, that the existence of these invisible killers was completely unsuspected while history's civilizations were tumbling. Only in the past century have laboratories unmasked an understanding of microparasites, and only in recent decades have historians begun to adopt a radically different view of the narrative of times gone by, paying attention for the first time to shifting disease patterns and their human consequences.

It is now clear that microbes have brought more death and destruction than all the wars and famines combined.

But there's good news: we have just entered a new era of technology – one that may allow us to defang the threat of infectious disease. Let's first turn to the effects of microbes on the survival of civilizations, and then examine the likelihood that future historians will have something new to fold into their models: the sudden effect that the internet had in preventing society-collapsing pandemics.

Historians have long asked a simple question: how could Hernando Cortez, the Spanish conquistador, bring fewer than 600 men to the New World and conquer millions of Aztecs? Similar military match-ups in history have tended to go less swimmingly. Surely the impressions left by Spanish rifles and horses deserve partial credit for his victories, but even those technologies are insufficient to explain the rapid crushing of an otherwise well-built society.

The secret weapon of the Spaniards was so secret that they themselves would not understand it for centuries: they carried with them a much larger army of smallpox viral particles. The immune systems of the Amerindians had no experience with this microbe, and although they could mount military defenses against horseback

attacks, they had no capacity to defend against the invisible war waged inside their bodies. Smallpox boasted an 80% to 90% fatality rate among the Amerindians. And even those who survived were psychologically tortured by witnessing their strongest and bravest brought down by a disease that left the invaders untouched.

What Cortez pulled off with the Aztec civilization, Francisco Pizarro soon repeated with his resounding defeat of the Inca Empire. As it turns out, the Native Americans were up against a formidable foe: smallpox is the most destructive disease in history, having claimed hundreds of millions of victims between ancient and modern times. The Romans lost up to a third of the population in parts of their empire. A millennium later, crusaders returning from the pillaging of distant lands brought an epidemic to Europe; it was from here that conquistadors transported the microscopic passengers to the New World. Off the coast of the Americas, smallpox cut down a third of the population of Iceland in 1707.

Smallpox is only one of dozens of invisible killers lurking in history's corners.

A single strain of bacteria – *Yersinia pestis*, the cause of the bubonic plague – has wreaked havoc for as long as there have existed written records. The plague rebutted the Persian invasion of Greece, opening the way for the Golden Age of Greece, only to return as the Plague of Justinian to devastate Constantinople and defeat the Byzantine Emperor's plan to rebuild the Roman Empire. Ongoing outbreaks of the plague diminished the populations along the Mediterranean coasts, which greatly aided the Muslim invasion of the region in the late 600s.

The plague bubbled around the planet for the next several centuries, flaring up vigorously and unexpectedly. By the 1300s, things began to worsen: the plague had spread to India, China, and the Middle East, and followed caravan routes to ports along the Black Sea.

In 1346, Tatars laying siege on the port city of Kaffa were infected by the plague – and in history's first episode of biowarfare they launched their diseased corpses over the walls of the city. When the Tatars left, the Italian traders inside the city scrambled out to return to Europe, unwittingly carrying with them the seeds of destruction: plague-infected rats. All the European ports they touched became infected, and within the next three years the Black Death erased one-third of the population of Europe. Towns were emptied, family members abandoned one another, minority groups were scapegoated, and political upheaval erupted.

The plague eventually died down and allowed Europe to enter the Renaissance, but it continues a cycle of unwelcome return. Recent

appearances in India, Madagascar, the Congo, and the United States remind us that these small bacteria still have their fingers on the trigger.

Smallpox and the black plague are only two deadly microbes to cut empire-defeating, border-bending paths through history. These invisible nihilists are accompanied by a menagerie of friends.

The influenza virus bestowed the 1918 epidemic – the worst in the twentieth century – which wiped out 20 to 40 million people in less than a year. But influenza had a long history before that, playing a series of society-crushing roles – from the deadly Plague of Athens in 430 BCE to the decimation of Charlemagne's army in 876 CE.

And consider the way that yellow fever, a small RNA virus, shaped the New World. The virus killed so many French soldiers that it led to the independence of the Haitian Republic: Napoleon decided not to sacrifice any more of his soldiers quelling the slave rebellion there. And the defeat in Haiti fueled Napoleon's decision to sell the Louisiana Territory to the young United States. He'd lost his appetite to deal with man-eating diseases he did not understand.

The list goes on. Consider malaria, a micro-organism that kills over a million people each year by invading and destroying red blood cells. Or think about violent epidemics of typhus, which killed 10 percent of the English population in the 1500s, millions of Germans in the Thirty Years War in the 1600s and was a major player in Pacific Theater battles during the Second World War.

These and other transmissible diseases have been twisting the plots in the stories of human civilizations all over the surface of the planet. Microbes are born anarchists: never ones to respect authority or national borders, they grant the same attention to emperors and queens as they do to the general populace.

This retrospective understanding of microbes' role in the narrative of civilizations has driven historians to an unlikely tool – the laboratory microscope. The human story is still evolving, and we are about to see that the next important plot twist will involve another unlikely player: your home–office computer.

THE SAFETY NET

Future epidemic threats are as certain as death and taxes; they are heading toward us with 100 percent certainty. We are still the same fragile biological creatures that we have always been, and with increasing globalisation new mutations are granted the opportunity to spread at the speed of jet travel. Modern urban centers crank up

pressure cuffs, blood sugar monitors or electrocardiographs.

Telemedicine does not even require the doctor and patient to be present at the same time: many diagnostic visits can be performed asynchronously. Currently, this is done mostly with the taking of images such as a brain scan or pathology samples, but for many other situations the patient history and diagnostic results can be shipped and stored to be analyzed with some time delay – just like the *in absentia* postal technique of times past.

Companies and hospitals are currently developing telemedicine because it is cost effective for remote or isolated regions. But I suggest that the effort should be equally concentrated within urban centers – the places that imagine they need telemedicine least. If enough telemedical peripherals get put into place, the real payoff will come with the arrival of the next wildly infectious agent. The cost-effectiveness will be measured at the scale of civilizations.

Telepresence and telemedicine allow us to reduce host density and keep epidemics down. But if that doesn't work and an epidemic hits anyway, the net gives us much better ways of tracking it to optimally direct our resources. And that is our third line of protection.

The idea of tracking flu outbreaks has been in play for a long while, but it's a difficult mission. How can we detect exactly where people are getting sick? After all, there's no central reporting system. Currently, the Center for Disease Control assiduously tackles the problem by communicating with hospitals to count up the number of flu diagnoses at each location around the country. In this manner, they can direct flu vaccines and other resources. This technique is successful – but it requires tremendous bureaucratic effort and lags the actual outbreak by two weeks.

So Google came up with a better idea. They noticed that when people get sick, they're likely to perform flu-related searches online – searches like 'how to treat the flu', 'why am I vomiting', 'what causes diarrhea', and so on. By dynamically mapping the locations and frequency of these queries, Google develops a high resolution picture of how microbes are painting the nation. Google's reports require no human effort and their reports don't lag outbreaks by two weeks. They lag by one day. And that facilitates an ultra-rapid response when resources need to be directed with precision.

HOW TO AVERT A PANDEMIC

There is a tight connection between the small scales of biology and the large sweep of history.

Global warming aids the dissemination of pathogen-carrying mosquitoes, meaning that many diseases have spread into areas where they previously did not exist. Our shifting societal structure – with increased international travel, regional conflicts and refugees – has led to the re-emergence of viruses we recently believed were contained or eliminated. That's the bad news. The good news is that our scientific understanding of disease is increasing rapidly. In the past two years we have sequenced the genomes of viruses, the mosquitoes that carry them, and ourselves.

As a result of this good and bad news, the battle between man and disease has reached a new level of intensity. We have new vaccines, but too large a population to disseminate them effectively. Moreover, while some diseases are knocked out of the game, new ones pop into existence. Could a new influenza epidemic decimate our civilizations? Could the re-introduction of old diseases through bioterrorism steer our future onto a different track?

We have argued here that the advent of the net may be the unlikely technology that tips the scales in our favor. Unlike previous generations that were brought down by disease, we now have at least three prongs of attack that may enable us to evade pandemics.

To appreciate your technological good fortune, imagine that the Amerindians had had the internet when the Spaniards arrived. Imagine they were equipped with the capacity to communicate remotely, be diagnosed and treated from within their own teepees, and that region-wide resources were distributed precisely where they were needed. The Americas would look quite different today.

Leveraging the net to avert existential risk does not come for free: there is work to be done.

First, we need to be well-prepared when an epidemic arrives. I envision a day when, at a signal from the Center for Disease Control, we can fluidly shift into a quarantined, telepresent society – one in which microbes fail by dint of host sparseness. Whatever the social ills of isolation, they bode worse for the microbes than for us.

To make this scenario plausible, businesses need to develop their epidemic plans. Companies can test out the work-from-home element of their disaster plans quite easily by simply having a subset of their employees work telepresently for a week. What breaks? What works well? With this strategy, they can discover the kinks in the plan and refine as needed. Businesses are the ones most incentivized to build telepresence plans, but at a broader level citizens need to get their governments involved in regional plans.

Next, communities need to develop their telemedicine strategies.

We need to make sure that all our neighbors don't choke up the medical centers at the first signs of infection: that would only repeat the high-density mistakes of the medieval Europeans or Native Americans.

To this end, I suggest that telemedicine development should be focused on dense urban centers at least as much as rural areas. While secluded areas sporadically need remote diagnosis now, city-dwellers may require the capacity much more dearly in the near future.

CHAPTER TWO

Rememberance of Things Past

In a battle between Julius Caesar and Ptolemy XIII, Caesar made the clever (if unusual) move of lighting fire to his own ships. This allowed him to set ablaze the oncoming Egyptian fleet as it maneuvered to corner him. The fire spread to the docks and had the secondary helpful effect of clearing away any cover from which the Egyptians might fire unwelcome arrows.

But there was collateral damage. The fire continued to spread from the docks and burned down the Library of Alexandria. The Library was the home to the world's largest collection of manuscripts at the time. Under Ptolemaic decree, all visitors to the city were forced to temporarily surrender their books for careful copying by scribes. Groups of scholars were hired for careful translation between Hebrew and Arabic and Greek. In parallel, requests were sent to neighboring countries to borrow and copy their most important texts. By these methods, 400,000 papyrus scrolls were collected and stacked – scrolls that held the learning and literature of Babylonia, Egypt, Greece, Macedonia, and much of the rest of the known world.

All the knowledge that had been collected over these decades was lost entirely in the fire. The astronomical charts, the mathematical treatises, the translated holy texts and stories and essays – all of these curled and browned from high information density to ashes.

The library was one of the Wonders of the Ancient World – and like all the rest of the Wonders except one, it is now just a memory.

The fate of the Alexandrian Library is more the rule than the exception of history. The learning and discoveries of the Maya met the same end in the bonfires of the Spaniards.

The Mayans had developed a sophisticated alphabet that resembled the hieroglyphics of the Egyptians, but phonetically represented spoken language. Although the Mayans occasionally etched these symbols into stone, their main medium was the codex: books made from bark paper and coated with lime to produce a white writing surface.

By 1517, Spaniards under the leadership of Hernández de Córdoba pulled their boats onto the shores of the Yucatan, carrying with them

Net-aided protests of the Iranian presidential elections, Azadi street, Tehran

The government leveraged their tools, as well. Ahmadinejad replied not only by banning rallies – but more importantly by blocking cell phone transmissions and text messaging and shutting down the net for 45 minutes to set up filtering software. Iran presumably could have opted to take the whole country offline permanently during this time, but in the cat-and-mouse game that option would cripple the government's crisis response communications as much as it would the protestors'.

In the end, the protestors won the digital race in this round in Iran, broadcasting the post-election oppression to a worldwide audience. But the countermeasures remind us of the critical nature of keeping the web open and online, an issue to which we will return in Chapter Seven.

Iran's use of digital technology was soon paralleled by similar movements around the Arab world. In January 2011, bloggers in Tunisia gained wide audiences as they wrote about their government's corruption. President Zine El Abidine Ben Ali had been in power for an astounding 23 years, and it was time to get him out. By documenting the events of their revolution online – using Facebook, Twitter, YouTube and blogs – young Tunisians were able to organize locations for protests. More generally, they made the world a witness to events and government crackdowns as they unfolded. Media giants like CNN and the BBC found themselves watching little salvos of 140 characters to understand what was happening. They were watching the protestors' news, not the other way around.

things are going bad. Given that a recent survey by Unisys found 61 percent of Americans in approval of the internet kill-switch concept, this issue will require constant vigilance. Tell your congressmen: back away from the switch, slowly.

4. Space Weather

When you think about the internet, you probably don't worry about what's happening on the surface of the sun 92 million miles away. But you should. Solar flares are one of our most serious threats for our communication systems.

Consider satellite failures. One fine day in 1998, the Galaxy IV – a $250 million satellite floating 35,000 kilometers above the planet – suddenly spun out of control. Although it is difficult to know for certain, it is suspected this was because of a solar flare: the sun was acting up at that time, and several other satellites (owned by Germany, Japan, NASA and Motorola) all failed at the same time. In any case, the effects were instant and worldwide. Eighty percent of pagers instantly went down. Physicians, managers and drug dealers all across the United States looked down and realized they were no longer receiving pages. NPR, CBS, Direct PC internet, CNN's airport network and dozens of other services went down. It is estimated that in recent years at least 12 satellites have been lost due to the effects of space weather.

But it's not just satellites that we have to worry about. When a massive solar flare erupts on the sun, it can cause geomagnetic storms on the earth. The largest solar eruption recorded so far was in 1859. Known as the Carrington flare, it sent telegraph wires across Europe and America into a sparking, fritzing frenzy.

Since that time, the technology blanketing the planet has changed quite a bit. If we were to get another solar flare of that size now, what would happen? The answer is clear to space physicists and electrical engineers: it would blow out transformers and melt down our computer systems. In a small disruption in 1989, an electromagnetic storm arrested power throughout most of Quebec and halted the Toronto stock market for three hours.

A major solar event could theoretically melt down the whole net. What earthquakes, bombs and terrorism cannot do might be accomplished in moments by a solar corona.

Given our dependence on the communication systems of our planet – both satellite- and ground-based, this is not simply a theoretical worry. The next major geomagnetic storms are expected at the peak of the next solar sunspot cycle during 2012 and 2013, so hang on tight.

PROPOSAL: A SEED VAULT FOR THE NET

The Global Seed Vault in Svalbard is wedged into a small island in the Arctic, halfway between mainland Norway and the North Pole. It's not a popular vacation destination unless you're Santa or a seed biologist. The vault is a secure bank for the future of the world. It holds duplicate samples – that is, spare copies – of seeds held in gene banks worldwide. The seed vault provides insurance in the event of large-scale regional or global crises. If a nuclear winter, say, were to wipe out all the crops on the planet, future generations could reboot the agricultural system by hoofing it out to Svalbard.

The Global Seed Vault in Svalbard

I propose that we need to have a similar back-up security plan for the human knowledge that underlies the net. I'm not talking about something like the Wayback Machine, which takes snapshots of websites through time. I'm talking about simple instructions, burned onto physical media, for how to generate electricity, how to build a computer, how to build a router and how to reconstitute the internet from basic principles. The net may be the single most important technology that's ever been invented. We have been the generation lucky enough to witness its inception, and we are now the ones responsible for its protection.

Remember life before the internet? Neither do I. But this book has been about reaching back into that not-so-distant past to understand