

Introducing the 21st Century's New Four Horsemen of the Coronapocalypse

Kang Hao Cheong*, Michael C. Jones

Science, Mathematics and Technology Cluster, Singapore University of Technology and Design, 8 Somapah Rd, S487372, Singapore

*Corresponding Author: kanghao_cheong@sutd.edu.sg

Both authors contributed equally.

Introduction

As the world struggles through the COVID-19 pandemic, we should also be asking which systems-level measures will be needed to prevent this or even worse disasters from happening in the future. We argue that the pandemic is merely one of potentially myriad and pleiomorphic future global disasters generated by the same underlying dynamical system. We explain that there are 4 broad but easily identifiable systemic, pathologically networked conditions that are hurtling civilization towards potential self-destruction. As long as these conditions are not resolved, we should consider catastrophe as an inevitable emergent endpoint from the dynamics. All 4 conditions can be reversed with collective action to begin creating an enduring and thriving post- COVID-19 world. This will require maximal application of the Precautionary Principle.

Even as global civilization is swept into the maelstrom of the COVID-19 pandemic, it is not too soon - in fact, we think gravely urgent - to understand the systemic conditions that made such a pandemic inevitable, and to understand why those conditions must be changed in order to prevent even worse, more complex, and possibly annihilatory events in the future. Our article is based on empirical observations, and the actions we recommend are based on maximal application of the Precautionary Principle [1,2].

COVID-19 is predicated on globalization. The pandemic has rapidly exposed a colossal lack of global preparation. The view is already widespread that the world will be drastically and permanently changed by this calamity, but no one is sure in what manner. Here we identify the "4 Horsemen" of this 21st century "coronapocalypse". Unlike the "traditional" 4 Horsemen (disease, war, pestilence and death) the new Horsemen are not types of destruction or endpoints but rather dynamically

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coupled, intensifying and chronic preconditions that make such destructive endpoints inevitable. The new Horsemen are:

1. Overpopulation
2. Globalization
3. Hyperconnectivity
4. Extreme centralization and reduced numbers of fragile supply chains

We believe each one is capable of great harm individually, but together they create a recipe for human extinction if they are not defused rapidly in the aftermath of COVID-19. How did humanity arrive at this critical juncture?

Beyond the pandemic: systemic conditions before and after

The onset is difficult to pinpoint, but for at least several decades prior to COVID-19 the push for globalization began "preparing the battlefield" in which humanity now finds itself. There were close calls with SARS, MERS, and H1N1, not to mention potential threats from Ebola and other zoonotic viruses including the ongoing, slow calamity of HIV. In addition, the rise of antibiotic-resistant bacterial pathogens, such as tuberculosis and *E. coli*, poses a nonviral threat. The collapse of global health systems caused by COVID-19 could unleash synergistic public health crises (e.g., cholera) caused by both known and unknown opportunistic pathogens. But there is much more besides germs to be gravely concerned about and which must be confronted after the COVID-19 disaster passes over. We have assessed that COVID-19 is an acute symptom of a convergence of systemic existential threats - the new 4 Horsemen - that have been growing like a global cancer for at least several decades. More importantly, we believe that the Horsemen will still be riding high after the pandemic and will bring even greater anguish in the future if they are not severely mitigated. We consider COVID-19 to be a tragic gift, a lens through which we can see the underlying fragility and intolerable volatility of our current pathological relationship with the natural world. However, this window of clarity may not last long; the most terrifying threat from COVID-19 is not COVID-19; it is the second, third and higher-order nonlinear and multiplicative effects (outbreaks of other diseases, such as cholera, Ebola and drug resistant TB; police and firemen unable to respond to massive fires; riots and looting; endless martial law; mass hysteria; famine; decapitation of national leaderships; flash wars and even nuclear war; colossal "financial stimulus packages" that will cause inflation, national debt and insolvency to skyrocket). Such effects could synergize into a chaotic snowball of global pandemonium with consequences that are limited only by the imagination. Or, in a scenario almost as bad as annihilation, an insufferable totalitarian system could arise as a desperate measure to hold the unsustainable global system together a little longer.

What we mean by "convergence" and "inevitability" when invoking the Precautionary Principle

The Precautionary Principle, when applied to situations that include total, irreversible ruin as a possible outcome, mandates that decision-making (or policies) rigorously prioritize the pro-active avoidance of ruin, even if the probability of ruin cannot be precisely measured [1]. When we say that the present course of global human activity is driving our species to inevitable catastrophe, even extinction, we do not mean we can predict either its timing or its triggers. To ensure survival, it is best to assume it could come soon and that many, many triggers could set it off.

In tornado chasing, the "triple-point" is a convergence of wind, pressure and moisture fields, at which the probability of a thunderstorm with tornadic potential can reach near-certainty. If one knows how to locate the triple point, all one has to do is drive there and wait for "the show" to begin. Unlike the relatively straightforward convergent physics of triple-point tornado prediction, the current global condition is hyperdimensional and massively nonlinear, including countless stochastic factors that can affect the trajectory of the system as it evolves toward the terminal end-state of human extinction. Many of the relevant variables are hard to name, much less quantify. We cannot insist that we forever await sufficient data to generate a concrete, deterministic "evidence-based" course of action. We think, however, that by framing the system in terms of a heuristic "quadruple-point" convergence of four broadly defined driving forces (or parameters), we can see the essential dynamics and the actions necessary to avert ruin. Whereas triple-point forecasting helps chasers get a close up view of a tornado, the "quadruple-point" forecast of the 4 Horsemen is about how to avoid ever getting even near total ruin; this means avoiding very large regions of parameter space not just for a while, but forever. For at least the last 70 years we have lived under a nuclear sword of Damocles put in place in Atomic War I (aka WWII) in which human self-extinction became a new possibility. Hydrogen bombs soon became just one of many potential agents of extinction, such as chemical and biological weapons. The global population explosion and massive urbanization into hundreds of sprawling mega-cities, along with massive rapid transportation systems, has produced channels of hyperconnectivity that easily convey the exponential global spread of catastrophe [3]. Mega-cities are sustained by massive and continuous supply chains with short-lived or almost nonexistent surpluses; for this reason, all mega-cities should be considered deathtraps waiting to snap shut, no matter how "thriving" they may appear. Like a patient dependent for survival on a ventilator, even a brief supply disruption can bring catastrophe to a mega-city very quickly. Hyperconnectivity within and between mega-cities further facilitates rapid pandemic transmission of potentially myriad forms of mega-crises besides contagious diseases. The majority of humans are now dangerously distant from the immediate tools of survival. The painful truth is that mega-cities are analogous to gigantic confined animal farming operations (CAFOs). Like CAFO chickens of centralized, commoditized agribusiness, humans are packed together in air conditioned cages (e.g., high-rise apartments) and fed processed food and antibiotics (to counteract the malnutrition that would otherwise come with restricted foraging, and the epidemic, shoulder-to-shoulder diseases that can wipe out the whole farm overnight); these compensatory measures keep the industrial machine pushing out product and ever-expanding, while at the same time the probability of eventual catastrophe relentlessly increases to inevitability. The closely related problem of pathological centralization and decreased number of supply chains [3], as we are seeing today in agonizing detail, is the final straw. Thus, we contend that for several decades we have been living under the increasingly leaden sky of the "quadruple point" of the new 4 Horsemen, the convergence of overpopulation, globalization, hyperconnectivity and increasingly fragile supply chains. This is lethal no matter the politics. The Horsemen form a deadly

team that generates a chronic supercritical state of explosive, unsustainable fragility and volatility, which is "the show" the world is watching in horror right now. We cannot overemphasize that even if the current scourge of COVID-19 does not result in civilizational meltdown *this time*, the 4 Horsemen, if not reined in, will continue galloping into an inevitable and final absorbing barrier of convergence: extinction. We are sounding the alarm that the 21st century's horrors (and opportunities) are just beginning. We may already be in a potential mass extinction of our own making, an Oecocidal catastrophe on the background of daily life that most people do not even notice. Global warming, rising sea levels, oceanic pollution, deforestation, topsoil loss, and numerous other macro-scale deteriorations are entangled in the growing global volatility. We believe humanity, as a swarm intelligence, must clearly perceive that our current business model is one of unacceptable misery now and assured suicide later, even if there is no way to prove it empirically. We also believe COVID-19 could be the spark for a massive and systematic revolution in the way human beings relate to the surrounding biological world.

What COVID-19 portends for biological theory and its role in society

We must focus on beating COVID-19 *now* but the existential issues raised by COVID-19 must be urgently dealt with in the aftermath; among other tectonic cultural and political transformations this will require shaking biology to its roots. A dangerously simplified model of the living state underlies our current malignantly pathological relationship with the biosphere. Despite its seemingly fantastic achievements, modern biology, as it is translated into policies and behaviors, is based on an antiquated, convenient, mostly reductionistic, low-dimensional "flat Earth theory" (FET). The incoherent and frantically misinformed response to COVID-19 exposes this inadequacy. FET was totally harmless a thousand years ago, but it would be a catastrophe today if airlines, shipping, and countless other things were based on FET. The same has happened in biology. "Biological FET" (BFET) does not easily accommodate complexity theory and often eschews it completely. The 4 Horsemen feast on BFET. Because of its low dimensionality we find ourselves today in a misguided world with some of the "experts" leading us into disaster with a BFET map. This low-dimensional map sacrifices explanatory and predictive robustness for tractable simplicity; it does its best to eliminate "noise" and stochasticity when instead it should embrace noise and stochasticity as fundamental, indispensable constructive and tunable forces of the living state. Of course, noise and stochasticity inevitably introduce nonlinearities, multimodalities and other troubling complexities in models that give reductionists terrible headaches. BFET is what underlies our current ecocidal rampage and the insane Ponzi scheme of continuous growth/globalization. Replacing BFET with a suitably high-dimensional understanding of the living state would change humanity and could save it from the unthinkable agonies that are fast approaching. Progress in this direction [4-6] has been mostly in the margins of academic research but the COVID-19 crisis may be just what the doctor ordered to bring it to the fore.

We will either learn to shape our institutions and collective behaviors to align with the multidimensionality and staggering complexity of biological reality, or the human species will likely perish just when it seemed we were invincible, at full throttle. Nothing could be more important to strive for. A good starting point is the observation that life is cellular in its basic organization. Imagine that someone makes a balloon that blows up into a life-sized effigy of (fill in the blank according to one's personal taste or distaste). Now suppose someone else carves another life-sized effigy out of

Styrofoam. You can throw darts at the latter all day and the effigy will laugh them off. But the slightest single pinprick will cause the former to catastrophically and irreversibly explode. Our world passed an unmarked, unnoticed threshold of criticality some decades ago and the tensions have become unbearable; the entire planet is now one big bottle of nitroglycerine, organized in a network topology that makes a death cascade of the entire system inevitable unless it is adaptively decoupled into the cellular topology of life [3]. COVID-19 is in-your-face proof that we are defying the only viable architecture that life has ever known. Life outflanks overwhelming odds with overwhelming numbers. Cellularity is a risk distribution strategy that results in survival [7,8]. Cellularity at multiple, nested scales (cells, organisms, species, ecosystems etc) is the secret of life's success, and it will be the secret to organizing human enterprise into a nested cellular topology that both avoids catastrophic shocks and is capable of dealing with them if they happen into the distant future. We will either learn to organize human society in a robust cellular architecture that emulates biological reality, or we will sooner or later end up like the balloon. BFET will have nothing to do with survival; in fact, BFET is potentially hastening our extinction.

We are experiencing a rapid and potentially liberating loss of collective innocence. For several decades we have been sailing on the Titanic, dancing in the ballroom to a chamber orchestra. Everybody ignored a little jolt and kept dancing, and the orchestra played on, but belowdecks water is gushing in, drowning crew. At some point the ship starts to list and suddenly everyone goes from partying to panicking. COVID-19 is waking up the world to the reality that we have engineered a booby-trapped planet with trip wires everywhere. We offer a blunt and necessarily unpleasant message. Bringing the Horsemen to a stop should be the supreme priority of the post-COVID-19 world. The human species will either reverse its catastrophic plunge into biological insanity, or it will die. The only real question is whether we are really on the Titanic (a few survivors) or the Hindenburg (0), or have embarked on a massive, supremely necessary change of course.

References

- [1] N. N. Taleb, R. Read, R. Douady, J. Norman, Y. Bar-Yam. arXiv preprint arXiv:1410.5787 2014.
- [2] K. H. Cheong, J. M. Koh, M. C. Jones. *BioEssays* 2019, 41, 7 1900032.
- [3] J. Norman. Global Decentralization for Risk Mitigation and security. *Researchers.One*, (<https://www.researchers.one/article/2020-02-15>), 2020. Assessed 22 March 2020.
- [4] D. Noble. *Interface focus* 2017, 7, 5 20160159.
- [5] K. H. Cheong, J. M. Koh, M. C. Jones. *BioEssays* 2019, 41, 6 1900027.
- [6] A. Annala, K. Baverstock. *Communicative & integrative biology* 2016, 9, 4 e1187348.
- [7] K. H. Cheong, J. M. Koh, M. C. Jones. *Proceedings of the National Academy of Sciences* 2018, 115, 23 E5258.
- [8] K. H. Cheong, J. M. Koh, M. C. Jones. *Fluctuation and Noise Letters* 2019, 18, 03 1971001.

Conflict of Interest

The authors declare no conflict of interest.

Keywords

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