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# Viral modernity? epidemics, infodemics, and the 'bioinformational' paradigm

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#### ABSTRACT

Viral modernity is a concept based upon the nature of viruses, the ancient and critical role they play in evolution and culture, and the basic application to understanding the role of information and forms of bioinformation in the social world. The concept draws a close association between viral biology on the one hand, and information science on the other - it is an illustration and prime example of bioinformationalism that brings together two of the most powerful forces that now drive cultural evolution. The concept of viral modernity applies to viral technologies, codes and ecosystems in information, publishing, education and emerging knowledge (journal) systems. This paper traces the relationship between epidemics, guarantine, and public health management and outlines elements of viral-digital philosophy (VDP) based on the fusion of living and technological systems. We discuss Covid-19 as a 'bioinformationalist' response that represents historically unprecedented level of sharing information from the sequencing of the genome to testing for a vaccination. Finally, we look at the US response to Covid-19 through the lens of infodemics and post-truth. The paper is followed by three open reviews, which further refine its conclusions as they relate to (educational) philosophy and the notion of the virus as Pharmakon.

#### **KEYWORDS**

bioinformationalism; Covid-19; epidemics; information science; postdigital; viral biology

#### Epidemics, quarantine, and public health management (Michael Peters)

Viruses exist only within the cells of living organisms, are found in most planetary ecosystems, and are the most numerous biological entities on Earth with trillions of varieties. They are thought to have played an essential role in the evolutionary history of life. As Nasir et al. (2012: 247) write:

Viruses are intriguing biological entities that are borderline between inanimate and living matter.... They often integrate into cellular genomes and massively enrich the genetic repository of numerous organisms, including animals, plants and fungi.... Viruses are believed to have played important roles in the evolution of cellular organisms.

Viruses are "remarkably abundant" and diverse with "numerous morphological forms and replication strategies". As Nasir et al. note, "viruses are considered unworthy of living status and their placement alongside cells in the 'tree of life' (ToL) unwarranted," and they go on to observe "the question about the origin of viruses and life itself remains for the most part a philosophical debate and largely dealt with theoretical arguments rather than molecular data, especially because viral genomic repertoires are limited and patchy." (Nasir et al., 2012: 247-248). The virusfirst hypothesis maintains there are three virospheres that can be physically linked but are functionally disjoint: Archaea, Bacteria, and Eukarya. On this hypothesis viruses are considered to contribute to the evolution of cells with an attempt to propose the "virocell" that links both. "Remarkably, viruses appear alongside with cells on a comparable evolutionary time scale and form a basal and distinct 'supergroup' in a truly universal ToL" (Nasir et al., 2012: 248).

Viral infections have always existed in human population; in some historical periods, diseases such as the Spanish Flu have affected large proportions of population.<sup>1</sup> In the absence of cure, already the Mosaic Law mentions procedures of separating out sick people to prevent spread of disease. The first organised isolation of *healthy* but *potentially sick* people took place in response to the Great Plague (also commonly known as Black Death) in 14<sup>th</sup> century in the independent trading city-state of Ragusa (now Dubrovnik, Croatia). In order to protect its citizens from the Plague, city authorities ordered that all ships and people need to be isolated for 40 days before entering the city. Medicine of the day did not know that the Great Plague had a 37-day period from infection to death. For luck or coincidence, this somewhat arbitrary measure has achieved full success. Derived from Italian words *quaranta giorni* meaning forty days, the quarantine has become standard epidemiology practice until today.

Large epidemics and pandemics have always been significant social and cultural events. For instance, between 1918-1919 the influenza pandemic "took the lives of between 50 and 100 million people worldwide, and the United States suffered more casualties than in all the wars of the twentieth and twenty-first centuries combined" (Outka, 2019). While its effects have been overshadowed by horrors of WWI and challenges of the interwar period, the influenza pandemic has nevertheless "shaped canonical works of fiction and poetry" through its "hidden but widespread presence" (Outka, 2019). Outka's work "uncovers links to the disease in popular culture, from early zombie resurrection to the resurgence of spiritualism", and "brings the pandemic to the center of the era, revealing a vast tragedy that has hidden in plain sight" (Outka, 2019). In the midst of current outbreak of Covid-19, historians are drawing lessons from media responses to the 1918-1919 pandemic; in spite of very different contexts, it seems that much can be learned from century-old experiences (Brockell, 2020).

In *Madness and Civilisation* Michael Foucault describes the Great Confinement, which was based on the model of the leper colony. While leprosy is not a virus, but rather a bacterial infection (*Mycobacterium leprae*) spread between people through extensive contact, in social terms its effective history led to a "game of exclusion" that for several centuries dominated structures of exclusion where the role of the leper was substituted by the poor, by vagrants, by prisoners, and by those considered "mad". Foucault (2006: 6) writes:

In the Middle ages, exclusion hit the leper, the heretic. Classical culture excluded by means of the General Hospital, the Zuchthaus, the Workhouse, all institutions which were derived from the leper colony. I wanted to describe the modification of a structure of exclusion. (Foucault, 1996, p. 8) Once leprosy had gone, and the figure of the leper was no more than a distant memory, these structures still remained. The game of exclusion would be played again, often in these same places, in an oddly similar fashion two or three centuries later. The role of the leper was to be played by the poor by the vagrant, by prisoners and by the 'alienated', and the sort of salvation at stake for both parties in this game of exclusion is the matter of this study. The forms this exclusion took would continue, in a radically different culture and with a new meaning, but remaining essentially the major form of a rigorous division, at the same time social exclusion and spiritual reintegration. (Foucault, 2006: 6)

In Abnormal: Lectures at the Collège de France, 1974-1975, Foucault (2007) contrasts the reductive view of power that excludes with a generative model based on lepers and "plague towns". In the former case lepers were excluded from society and forced to wear bells around their neck to warn others of their advance. By contrast, in the case of "plague towns" it was impossible to control through exclusion. Instead the solution adopted was quarantine that was a method assisted by urban form that had divided towns into smaller and smaller section (quadrillage) where streets were controlled and policed twice daily through roll calls and registers that recorded the latest victims who were removed. It was a form of pyramid administrative control where continuous surveillance operated. As Foucault (2007) explains

It is not exclusion but quarantine. It is not a question of driving out individuals but rather of establishing and fixing them, of giving them their own place, of assigning places and of defining presences and subdivided presences. Not rejection but inclusion. You can see that there is no longer a kind of global division between two types or groups of population ... one that has leprosy and one that does not ... There is a close and meticulous observation ... [a] constant examination of a field of regularity within which each individual is constantly assessed in order to determine whether he conforms to the rule, to the defined norm of health (Foucault, 2007: 45-7).

The plague referred to as the Black Death is also due to a bacterial infection (*Yersinia pestis*) generally found in animals, especially rodents, and transmitted through fleas. The risks of getting the plague were highest in crowded and congested areas, normally in the poorest section of a city, where sanitation is poor or non-existent. There are several forms of plague – (septicemic, pneumonic and, the most common, bubonic) – that is thought to have originated in East Asia and travelled along the Silk Road, reaching Sicily in 1347 and reducing the population by over 100 million.

Foucault contrasts the "ritual of exclusion" in dealing with lepers with plague towns that gave rise to "disciplinary diagrams" that involved "multiple separations, individualising distributions, an organisation in depth of surveillance and control, an intensification and a ramification of power" (1975: 231). In dealing with plague towns, as Elden observes

the 'emergency plan' [plan d'urgence] for epidemic disease comprised the following measures:

1. All people must remain at home in order to be isolated in a particular place, even in a single room;

2. The town is divided into distinct sectors or regions, inspectors patrol the streets, and a system of generalised surveillance is used to compartmentalise and control;

3. To accompany the detailed reports that come from these sectors, there will be a centralised information system;

4. People who do not show themselves for the inspectors at their windows will undoubtedly have contracted the plague, and therefore must be transported to a special infirmary, outside the town. Statistics can be derived from the reports that follow;

5. Houses need to be disinfected and sterilised ... (Elden, 2003: 243)

#### As Elden goes on to note:

The exile of the leper and the arrest of the plague do not bring with them the same political dream. The first is that of a pure community, the second that of a disciplined society" (1975, pp. 231-2): the military model of organised discipline replaces the religious model of exclusion (1994, Vol. III, p. 218). Two forms of the utilisation and control of space – exclusion and inclusion-organisation – two forms of political power – negative and positive. The positive form of power is the birth of administrative and political strategies (1999, pp. 44). Its four modes are selection, normalisation, hierarchisation, and centralisation (1997a, 161). Although these are used in *Discipline and Punish* to trace the emergence of the disciplinary society more generally, in its earlier context Foucault is more interested in public health campaigns. He suggests that "urban medicine, with its methods of surveillance, hospitalisation, etc. is nothing other than the development... of the political-medical plan [schema] of quarantine" (1994, Vol. III, pp. 218-9). (Elden, 2003: 243-244)

Foucault's analysis has an uncanny application today in the public health management strategies for dealing with Coronavirus (Covid-19) with haunting images of empty streets in Wuhan and other Chinese cities, with face masks and body-suited medicos.

#### Viral modernity? Elements of viral-digital philosophy (VDP)

Viral modernity is a concept that is based upon the nature of viruses, the ancient and critical role they play in evolution and culture, and the basic application to understanding the role of information and forms of bioinformation in the social world. The concept draws a close

association between viral biology on the one hand and information science on the other – it is an illustration and prime example of bioinformationalism (Peters, 2012) that brings together two of the most powerful forces that now drive cultural evolution. The concept of viral modernity applies to viral technologies, codes and ecosystems in information, publishing, education and emerging knowledge (journal) systems. Evolutionary bioinformatics indicate the conceptual closeness between the two.

Philosophy and the humanities more general are marked by two emergent and profound developments that have already begun to determine their future shape and major theoretical preoccupations: the ecological turn and the digital turn. At the most basic level the ecological humanities share an *ontology of interconnectivity* with the new digital technologies and together decentre humanity and redefine it as part of larger *living and technological systems*. This paper examines and speculates on the intermeshing of these two systems by inquiring into new possibilities for thought and research provided for by the concept of 'viral modernity'. Gillings et al. comment in 'Information in the Biosphere: Biological and Digital Worlds':

Evolution has transformed life through key innovations in information storage and replication, including RNA, DNA, multicellularity, and culture and language. We argue that the carbon-based biosphere has generated a cognitive system (humans) capable of creating technology that will result in a comparable evolutionary transition. Digital information has reached a similar magnitude to information in the biosphere. It increases exponentially, exhibits high-fidelity replication, evolves through differential fitness, is expressed through artificial intelligence (AI), and has facility for virtually limitless recombination. Like previous evolutionary transitions, the potential symbiosis between biological and digital information will reach a critical point where these codes could compete via natural selection. Alternatively, this fusion could create a higher-level superorganism employing a low-conflict division of labor in performing informational tasks. (Gillings et al., 2016: 180)

Gillings et al. (2016: 183) provide a timeline for the evolutionary development of information in the biosphere (Figure 1), and suggest that the collective body of technology can be regarded as "self-organizing (adaptive), energy transforming (produces, consumes, and exchanges energy with the environment), and auto-poietic (self-producing new technology from its own parts)" that leads some scholars to consider technology as "a living organism" where information in its viral form is regarded as a replicator, with similar properties to biological replicators. Such a parallel employs a model of understanding that sees words and genes in terms of increasing fidelity of replication through time.

It seems inevitable that digital and biological information will become more integrated in the future. This scenario raises the question of how such an organic–digital fusion might become a symbiosis that coevolves through natural and artificial selection. In a fusion of digital and biological systems, both could contribute their functions to generate a higher unit of organization, similar in effect to previous evolutionary transitions [43]. Such a transhuman vision is referred to as the technological singularity [79]. (Gillings et al., 2016: 188)

If we imagine this bioecological model of information, we can discern both an "ecology of good ideas" such as that expressed in the virtuous circle of exchange that takes place in open science where information is shared and build upon by members of the scientific community, and an "ecology of bad ideas" as the viral circulation of fake news in a post-truth world (Peters et al., 2018). Gregory Bateson (1972: 492) remarks: "There is an ecology of bad ideas, just as there is an ecology of weeds." The rest of that sentence that gets forgotten has a special valence in an age of post-truth, Bateson continues, "and it is characteristic of the system that basic error propagates itself". The history of the basic error that keeps getting propagated Bateson maintains is the idea of 'self' that we have been acculturated to in the West and that has become part of our eco-mental system as the basic operating premise of our thought and experience. Anthropologically speaking, nineteenth century evolutionists encourage an erroneous way of viewing our relations with the environment destroying the earlier forms of animism that was based on an empathy with the natural environment and separating "the notion of mind from



Figure 1. Schematic timeline of information and replicators in the biosphere (Gillings et al., 2016: 183).

the natural world" (Bateson, 1972: 493). The "mind separate from the body, separate from the society, and separate from nature" is the fundamental error that Bateson attacks and tries to rectify in *Steps Toward an Ecology of Mind* (1972).

#### Bioinformationalism: Information theory and genomics (Petar Jandrić)

With the advent of computer technology in mid-20<sup>th</sup> century, the humankind has started to produce and share large amounts of data. The early digital age is predicated on the assumption of openness and free sharing of information; openness involves a set of technical and other standards which allow sharing of information, while freedom refers to various legal and other standards pertaining to sharing of information. However, the computer industry has soon started to develop various obstacles to openness and freedom of information from corporate and military security protections to copyrights. In response, activists and hackers have stated to develop computer viruses – computer programs designed to modify other computer programs and spread themselves through replication. Some computer viruses are developed to explore and fix bugs in computer systems (so-called white-hat hacking) while other computer viruses are developed to cause damage and/or loss of information (so-called black-hat hacking) (see Jandrić, 2019a).

Whatever their purpose, computer viruses bring about a viral modernity which "challenges and disrupts the openness of a free distribution model as well as distributed knowledge, media and learning systems" (Peters, 2012: 62). Just like in biological systems (human body), "the virus flourishes because of the computer's capacity for information sharing and the computer is

unable to distinguish between a virus and a program. The alterability of information allows the virus to modify and change information, providing conditions for self-replicability" (Peters, 2012: 62). Fred Cohen has therefore advocated "the benevolent virus and friendly contagion as a foundation of the viral ecosystem instead of the corporate response to securitize and privatize all open systems through sophisticated encryption" (in Peters, 2012: 62). Already in 1994, "some scientists begun to ask if computer viruses are not a form of artificial life—a self-replicating organism. Simply because computer viruses do not exist as organic molecules may not be sufficient reason to dismiss the classification of this form of 'vandalware' as a form of life." (Spafford 1994: 249)

Roughly since the brink of the millennium, traditional computer systems have slowly but surely given way to various artificial intelligences.

According to Liza Daly, 'artificial intelligence is the umbrella term for the entire field of programming computers to solve problems. I would distinguish this from software engineering, where we program computers to perform tasks.' (Daly 2017) This simple definition describes an important paradigm change in the inner workings of the computer. Traditional computers, including the most sophisticated expert systems of yesterday, consisted of long lines of code which determined their behaviour: for every input, such systems would do predetermined calculations and provide an output. In contrast, Al systems are provided with some initial rules of behaviour, and then they are 'taught' by large datasets. Then, a computer independently establishes various connections between input data and produces 'intelligent' solutions to new problems in non-predetermined ways. This is the essence of machine learning, which is broadly defined as 'the science of getting computers to act without being explicitly programmed' (Ng 2018) (Jandrić, 2019b: 31–32)

Artificial intelligences cannot suffer from traditional computer viruses, although some computer viruses (and anti-virus programs) may contain elements of artificial intelligences. The advent of artificial intelligences has reinvigorated debates about distinctions between humans and machines exemplified in Turing's test, and has brought about various philosophies and research approaches such as sociomaterialism, posthumanism, actor-network theory, and science and technology studies (Jandrić, 2017: Chapter 9).

In late 20<sup>th</sup> century human society has experienced a vast wave of digitalization. We digitized images, music, books, and (human) genome. In 1996, the cloning of Dolly the Sheep has marked a symbolic change in research direction.

We're actually starting at a new point: we've been digitizing biology, and now we're trying to go from that digital code into a new phase of biology, with designing and synthesizing life. So, we've always been trying to ask big questions. 'What is life?' is something that I think many biologists have been trying to understand at various levels. We've tried various approaches, paring it down to minimal components. We've been digitizing it now for almost 20 years. When we sequenced the human genome, it was going from the analog world of biology into the digital world of the computer. Now we're trying to ask: can we regenerate life, or can we create new life, out of this digital universe? (Venter, 2008)

Following the shift from digitization of biology to biologization of the digital, century-old primacy of physics has now given way to biology. According to Dyson (2007), "[b]iology is now bigger than physics, as measured by the size of budgets, by the size of the workforce, or by the output of major discoveries (...). Biology is also more important than physics, as measured by its economic consequences, by its ethical implications, or by its effects on human welfare." This shift in relative importance between physics and biology does not imply that physics has become obsolete (on the contrary, digital tools have now become indispensable in biosciences) or that the value of (human) life has suddenly risen in importance. Instead, the rise of bioinformationalism has merely marked new research directions in our sciences, inspired by social and cultural changes and enabled by technological developments, at our current historical conjecture.

This curious mix of "blurred and messy relationships between physics and biology, old and new media, humanism and posthumanism, knowledge capitalism and bio-informational capitalism" (Jandrić et al., 2018: 896) is often described by the notion of the postdigital. According to Peters and Besley (2014: 30), "[t]he postdigital does not describe a situation, condition or event *after* the digital. It is not a chronological term but rather a critical attitude (or philosophy) that inquires into the digital world, examining and critiquing its constitution, its theoretical orientation and its consequences." In our postdigital age, contagious diseases such as Covid-19 are at the same time biological (they arrive from nature, and affect human bodies), social and cultural (they illicit socially and culturally constructed responses) and digital (Covid-19 research is enabled and powered by digital technology). Developed within a postdigital context, world's response to the threat of Covid-19 says a lot about the viral nature of our modernity.

#### Covid-19 – the bioinformationalist response

According to the World Health Organisation (2020), "the current outbreak of coronavirus disease (Covid-19) (...) was first reported from Wuhan, China, on 31 December 2019." 30 days later, on 31 January 2020, UK's Wellcome Trust issued a statement entitled 'Sharing research data and findings relevant to the novel coronavirus (Covid-19) outbreak'. Initially signed by 67 large organisations such as the European Commission and mainstream academic publishers such as Elsevier and Springer Nature, the statement committed to ensure that:

- all peer-reviewed research publications relevant to the outbreak are made immediately open access, or freely available at least for the duration of the outbreak
- research findings relevant to the outbreak are shared immediately with the WHO upon journal submission, by the journal and with author knowledge
- research findings are made available via preprint servers before journal publication, or via
  platforms that make papers openly accessible before peer review, with clear statements
  regarding the availability of underlying data
- researchers share interim and final research data relating to the outbreak, together with protocols and standards used to collect the data, as rapidly and widely as possible - including with public health and research communities and the WHO
- authors are clear that data or preprints shared ahead of submission will not pre-empt its publication in these journals (Wellcome Trust, 2020)

Within days, research organisations have started to share results of their work on Covid-19 and academic publishers have quickly developed global infrastructure which enables such sharing. For instance, immediately after signing the statement, Springer Nature added a banner saying "Springer Nature is making SARS-CoV-2 and Covid-19 research free" to all their journals (Springer Nature, 2020). Clicking on the banner leads to a landing page containing an introductory text followed by continuously updated links to various articles and books relevant for Covid-19.

SARS-CoV-2 is a new virus responsible for an outbreak of respiratory illness known as Covid-19, which has spread to several countries around the world. As a leading research publisher, Springer Nature is committed to supporting the global response to emerging outbreaks by enabling fast and direct access to the latest available research, evidence, and data.

Below are related research articles from our journals, as well as additional commentary on this topic and relevant books. All content listed here is free to access. If you are not able to access an article that you believe to be important in both understanding and addressing this emergency, please contact our customer services team.

Springer Nature encourages early sharing of research submitted to all our journals through preprints, and our In-Review preprint service is available for many journals. We strongly urge authors submitting articles related to this emergency to share underlying datasets relating to the outbreak as rapidly and widely as possible. We are a signatory on the consensus statement, Sharing research data and findings relevant to the novel coronavirus (nCoV) outbreak. (Springer Nature, 2020)

The page also links to useful external resources such as live information about the virus<sup>2</sup> and World Health Organisation's dedicated webpage.<sup>3</sup> Latest data about the 2019 Novel Coronavirus Visual Dashboard operated by the Johns Hopkins University Center for Systems Science and Engineering (JHU CCSE) was made available in real time on GitHub.<sup>4</sup>

This historically unprecedented level of sharing information has guickly brought about some impressive results. Within weeks, Chinese scientists "had sequenced the viral genome, deciphering the virus's genetic code — a vital key to diagnosing and ultimately treating the disease. They immediately shared that critical genetic roadmap with researchers all over the world. That early collaboration allowed doctors in other countries to be ready when the first cases appeared outside China." (Crowe, 2020) At the moment of writing these words, Google Scholar search for articles about the Covid-19 virus published between 1 January and 28 February 2020 returns 2,140 unique results. One of these articles, 'Time Course of Lung Changes On Chest CT During Recovery From 2019 Novel Coronavirus (Covid-19) Pneumonia', is based on examination of "patients with RT-PCR confirmed Covid-19 infection presenting between 12 January 2020 to 6 February 2020" (Pan et al., 2020). The study was published online on 13 February, which is 7 days after the last patient was examined. This ground-breaking reaction of medical profession brings sends a larger message. "When the story of the coronavirus (2019-nCOV) is finally written, it might well become a template for the utopian dream of open science — where research data is shared freely, unrestrained by competition, paywalls and patents." (Crowe, 2020) While the exact flow and dynamic of the collective response to Covid-19 will surely be analysed long after the epidemic is gone, let us look into some major changes it introduced to the scientific community.

#### The bioinformationalist challenge of open science

Standard academic publishing is a slow enterprise. Scientists do their research, write up their results, and submit their manuscripts to relevant academic journals for double-blind review which typically involves the following steps:

- 1. Admin check (writing style, clarity, originality)
- 2. First reading by the editor
- 3. The first round of double-blind peer review
- 4. Second editor's check
- 5. Decision goes to author:
  - 1. Accept
  - 2. Accept with minor changes
  - 3. Accept with major changes
  - 4. Reject
- 6. Author submits the next version
- 7. The second round of double-blind peer review
- 8. If necessary, the third round of double-blind peer review
- 9. Final decision article goes to production.

Depending on journal, this process can take anywhere between few months and few years. To support swift response to the Covid-19 crisis, academic editors have significantly increased speed of peer review. In their Editorial, Eric J. Rubin, Lindsey R. Baden, Stephen Morrissey, and Edward W. Campion of *The New England Journal of Medicine* have put together a set of practices to "rapidly evaluate submitted manuscripts and, if we plan to publish them, will expedite all editorial steps to make them available as quickly as possible" (Rubin et al., 2020). Academic editors have done their best to keep integrity of their work. "Some of these articles have been reviewed and edited and revised in 48 or even 24 hours, including working overnight and weekends but

still going through rigorous peer review to meet the standards that we think are important." (Campion in Crowe, 2020) Despite all precautions, however, some published articles have already been proven wrong. Published on 31 January, preprint article 'Uncanny similarity of unique inserts in the 2019-nCoV spike protein to HIV-1 gp120 and Gag' (Pradhan et al., 2020) has received "90 critical comments within 48 hours and was swiftly retracted" (Kupferschmidt, 2020); on 14 February 2020, results of the paper were officially debunked in another publication (Xiao et al., 2020).

After publication, academic articles get listed in various databases of academic material. Noncurated databases, such as Google Scholar,<sup>5</sup> automatically list new publications few days after publication; however, this automatic process can include a lot of non-relevant or even fake material. Curated databases, such as Web of Science,<sup>6</sup> take much longer to list new articles, yet their protocols guarantee certain level of relevance and verifiability of listed research. 59 days after the outbreak,<sup>7</sup> the non-curated database Google Scholar lists 2,140 relevant articles for Covid-19, while the curated database, Web of Science, lists only one relevant article. Preprint repositories such as bioRxiv and medRxiv lie somewhere in the middle between non-curated databases such as Google Scholar and curated databases such as Web of Science. Articles published in these repositories get some dedicated attention, yet many of them, including the abovementioned retracted article 'Uncanny similarity of unique inserts in the 2019-nCoV spike protein to HIV-1 gp120 and Gag' published at bioRxiv, are published with disclaimers such as: "This article is a preprint and has not been certified by peer review" (Pradhan et al., 2020). On 26 February, Kai Kupferschmidt wrote

Early this week, more than 283 papers had already appeared on preprint repositories (see graphic, below), compared with 261 published in journals. Two of the largest biomedical preprint servers, bioRxiv and medRxiv, "are currently getting around 10 papers each day on some aspect of the novel coronavirus," says John Inglis, head of Cold Spring Harbor Laboratory Press, which runs both servers. The deluge "has been a challenge for our small teams ... [they] are working evenings and weekends." (Kupferschmidt, 2020)

This deluge of Covid-19 related articles does not only affect academic editors and publishers; more importantly, it significantly influences researchers and their research. In 2020, researchers looking for Covid-19 related academic articles in non-curated Google Scholar were faced with reading an average of 36 articles per day. Restricting themselves to more reliable sources such as combination of preprints and academic journals, researchers nevertheless need to read approximately 10 articles per day. With one relevant paper indexed in 2020, traditional curated database of Web of Science is currently of no use. Furthermore, the number of preprints and publications with relevant keywords in January-February 2020 has risen exponentially (see Figure 2). While it is impossible to predict whether this rate of growth will continue in the future, the number of Covid-19 related preprints and publications may soon become too large for human comprehension. In a matter of days or months, Covid-19 research could reach the problem of 'undiscovered public knowledge' described already in 1986 by the University of Chicago library scientist Don Swanson (1986). According to Steve Fuller, this problem consists of at least three levels: "1) there's more stuff than can be reasonably read; 2) disciplinary specialisation exacerbates the problem; 3) as a result, when we ask money for 'new research', we may end up reinventing the wheel, in the sense that the answer may already exist and we just don't know it." (in Fuller & Jandrić, 2019: 200). Some of these problems might perhaps be resolved through various applications of Artificial Intelligences, yet this implies that Covid-19 research is now reaching beyond medical profession to include data experts, computer scientists, and others.

I am writing these words on 28 February 2020, which is 59 days after the official outbreak of the Covid-19. With daily reports of more and more cases of infections and death, the epidemic is still in full swing. Responses developed by the global research community during January and February 2020 have already returned some fascinating results – virus genome has been mapped, reliable tests have been developed, and the first vaccine trial has started (Park, 2020). There is no

### Information revolution

Scientists are sharing more information using preprints than they did during any previous outbreak. The number of published papers is exploding as well.



Figure 2. Number of Covid-19 related preprints and publications in January-February 2020 (Kupferschmidt, 2020).

doubt that such developments would not be possible without the principles of open science – free sharing of datasets and research results, quick review and publishing procedures, and, above all, decommodification of all Covid-19 related research. However efficient, the principles of open science are soon bound to bump into some natural limitations including but not limited to questionable verifiability of (some) published results to data deluge. Therefore, it is crucial that philosophers, information scientists, and other experts in knowledge development urgently join medical researchers in our common struggle against this deadly threat to humanity.

## A virus of misinformation: Infodemics and the US Response - A case in point (Peter McLaren)

"I haven't touched my face in weeks. It's been weeks! I miss it." —President Donald Trump (Salvador Hernandez, Buzzfeed News, March 4, 2020)

When a top official from the US Centers for Disease Control and Prevention said the agency expects the coronavirus will begin spreading at a community level in the United States, President Trump "responded that U.S. containment of the virus is 'close to airtight' and that the virus is only as deadly as the seasonal flu" (Thielking, 2020). Now a Pro Publica report has made it clear that as a result of shunning World Health Organization disease test guidelines, the US lost crucial time in tracking the spread of the coronavirus and Covid-19. The US insisted on devising its own test, resulting in an overreliance on the development of a specifically American test. Currently commercial manufacturers across the US are working around the clock to mass-produce coronavirus tests. And yet still needed, as of this writing, is a broadening of the criteria for testing. Pro Publica reports

As the highly infectious coronavirus jumped from China to country after country in January and February, the U.S. Centers for Disease Control and Prevention lost valuable weeks that could have been used to track its possible spread in the United States because it insisted upon devising its own test. The federal agency

shunned the World Health Organization test guidelines used by other countries and set out to create a more complicated test of its own that could identify a range of similar viruses. But when it was sent to labs across the country in the first week of February, it didn't work as expected. The CDC [U.S. Centers for Disease Control and Prevention] test correctly identified Covid-19, the disease caused by the virus. But in all but a handful of state labs, it falsely flagged the presence of the other viruses in harmless samples. As a result, until Wednesday the CDC and the Food and Drug Administration only allowed those state labs to use the test — a decision with potentially significant consequences. The lack of a reliable test prevented local officials from taking a crucial first step in coping with a possible outbreak — "surveillance testing" of hundreds of people in possible hotspots. Epidemiologists in other countries have used this sort of testing to track the spread of the disease before large numbers of people turn up at hospitals. (Pro Publica, 2020)

Egregious failures followed the dissemination of the first test kits that were sent out from a laboratory in Georgia—a laboratory that, understandably, is no longer under government contract. According to Terry Schwadron (2020), "[t]he White House has insisted only on centralizing messaging on the disease, a power it has used to attack perceived political foes for anything that has goes wrong — as if that makes it any easier to feel secure about illness." Seizing control of all official communications about coronavirus, while at the same time weaponizing the virus to attack political rivals in the Democratic Party, has proven to be an unmitigated disaster, putting lives at imminent risk.

The US citizenry is not getting the information needed to prevent the spread of the coronavirus as the public attempts to fight the spread of Covid-19 in tandem with a politically weaponized virus of misinformation hatched in the fetid wheelhouse of a leader who likely suffers from narcissistic personality disorder and who is currently gripped by a paralyzing fear of losing an election. What US residents are receiving is a slew of conspiracy theories regarding the nature and origin of the virus. One such conspiracy centers around the claim that the virus was created in a laboratory. According to Gregory:

Much of the misinformation centers on the unfounded claim that the virus was created in a laboratory. In one version of this false story, the source of the outbreak can be traced to Chinese spies who stole the virus from a lab in Canada, then mutated it into a biological weapon before it leaked out from a state-owned virology lab in Wuhan, China — where the first case of Covid-19 was identified. (Gregory, 2020)

Many other social media reports have a similar conspiratorial and unsubstantiated ring to them. But there are other, more challenging barriers to truthful information about the coronavirus. Schwadron (2020) has catalogued some of the bureaucratic and political bulwarks that were already in place when the US decided to take Covid-19 seriously. According to Schwadron (2020) they are numerous. He mentions

... reports circulating in the news media, in on-line forums and posts, and from conflicting remarks from government sources about other aspects of the U.S. government response towards vaccine development, mask production, where to place and care for quarantined patients and any needed stockpiling of medicines that depend on Chinese supply lines. Of course, this administration also had dismissed an existing infectious disease response panel, proposed significant cuts in public health and for the CDC [U.S. Centers for Disease Control and Prevention], where a number of vacancies remain unfilled, and generally has conducts big campaigns against Obamacare, Medicare and Science. It has done nothing publicly to ask social media companies to quash bad health information. (Schwadron, 2020)

Testing capacity was not distributed across local health departments when the CDC (U.S. Centers for Disease Control and Prevention) began investigating a case in California in which the patient was suspected of being the first infected in the United States without having traveling to affected areas or without being knowingly exposed to someone with the illness who had recently travelled outside the country. Clearly, federal, state and local officials should have already been engaged in widespread surveillance testing in order to accommodate this suspected patient, but they were soon entangled in a bureaucratic quagmire. Again, Schwadron (2020) captures the confusion:

Doctors at the University of California, Davis Medical Center, where the patient is being treated, said testing was delayed for nearly a week because the patient didn't fit restrictive federal criteria, which limits tests only to symptomatic patients who recently traveled to China. "Upon admission, our team asked public health officials if this case could be Covid-19," UC Davis said in a statement. UC Davis officials said because neither the California Department of Public Health nor Sacramento County could test for the virus, they asked the CDC [U.S. Centers for Disease Control and Prevention] to do so. But, the officials said, "since the patient did not fit the existing CDC criteria for Covid-19, a test was not immediately administered." After this case, and under pressure from public officials, the CDC broadened its guidelines Thursday for identifying suspected patients to include people who had traveled to Iran, Italy, Japan or South Korea. (Schwadron, 2020)

We would expect that people with a discerning, critical mind would understandably be alarmed at the idea that a widely-known vaccination critic, Donald Trump, was now in charge of the White House during a pandemic. We were not surprised by the outrage that followed from citizens of every stripe. Below are some of the tweets sent by Trump in 2012 that surely justify such outrage:

"A study says @Autism is out of control-a 78% increase in 10 years," Trump tweeted in 2012. "Stop giving monstrous combined vaccinations immediately. Space out small individual shots-small babies can't handle massive doses. Get smart-and fast-before it is too late." (cited in Burris, 2020)

"I have received many notes of thanks from people regarding my comments on vaccines and autism," Trump said later that year. "The autism and vaccine safety community is encouraged that I've been willing to speak up on this issue. I feel strongly about it-and I'm pleased my remarks have had significance concerning this health crisis. Stop massive one time vaccinations-spread them out over a period of time." (cited in Burris, 2020).

#### The anti-vaccinationist's vaccination

After a decade of bloviating against vaccinations, Trump is now bragging that a coronavirus vaccine is just around the corner. Trump is clearly desperate to deploy a vaccine to Covid-19 before the next election and he has pressed pharmaceutical executives and public health officials to do just that. Trump believes that news of an imminent vaccine could help stabilize markets, and stem the rising tide of harsh criticisms of his administration's handling of the coronavirus pandemic. And, of course, help Trump's election chances. Trump has repeatedly derided the Democrats and the left (and even Fox News when they occasionally criticize Trump) for misrepresenting Trump's (according to him) grandiose achievements (Palma, 2020). Consider this following tweet:

"@FoxNews is working hard pushing the Radical Left, Do Nothing Democrats," Trump tweeted. "They want to be, unlike their competitors, @CNN & MSDNC (Comcast), Fair & Balanced. When will they ever learn. The Radical Left never even gave @FoxNews permission to partake in their low rated debates!"

Trump supporters are very likely to follow Trump's directives to ignore any news reports from mainstream news outlets such as CNN, NBC or ABC. Therefore Trump is careful about how he stage-manages the image of his handling of the coronavirus as it spreads throughout the US. Trump has pleaded with Big Pharma executives to come up with a vaccine before November's election (Rupar, 2020). It is very likely that new drugs to treat patients infected with the virus will make an appearance much sooner than vaccines (Thielking, 2020). Rupar describes the chaos surrounding the situation:

"I mean, I like the sound of a couple months better, if I must be honest," Trump said, seemingly oblivious to the fact that the "couple months" time frame execs mentioned merely referred to a vaccine being ready for trials. Later, Trump pressed the pharmaceutical leaders on why they can't just release the coronavirus drugs their companies are working on tomorrow — in the process revealing that he doesn't understand the concept of clinical trials. "So you have a medicine that's already involved with the coronaviruses, and now you have to see if it's specifically for this. You can know that tomorrow, can't you?" he said. "Now the

critical thing is to do clinical trials," explained Daniel O'Day, CEO of Gilead Sciences, which has two phasethree clinical trials going for remdesivir, a potential treatment for the coronavirus. "We have two clinical trials going on in China that were started several weeks ago ... we expect to get that information in April." Trump also wondered aloud why the flu vaccine can't just be used for coronavirus, asking, "You take a solid flu vaccine, you don't think that could have an impact, or much of an impact, on corona?" "No," one of the experts at the table replied. Following the meeting, an unnamed administration source told CNN that they thought the scientists and experts were able to convince Trump that a vaccine would not be available for a year or longer. "I think he's got it now," the source told CNN. (Rupar, 2020)

And yet, only hours after being told by medical experts that a vaccine would be unavailable for at least a year, Trump proclaimed at one of his rallies that a vaccine would be available relatively soon. Foreseeably, Trump took an "ethnonationalist stance" on the virus, arguing that "[t]here are fringe globalists that would rather keep our borders open than keep our infection — think of it — keep all of the infection, let it come in" (cited in Rupar, 2020). Trump has also expressed bewilderment about "the difference between cures, which eliminate diseases, and therapies, which treat them" (Rupar, 2020). Trump has consistently and confusingly conflated these terms. In order to keep numbers artificially low, for fear of the stock market plummeting, Trump delayed testing, and then lied about the availability of tests. And even as the pandemic rages across the US, Trump and his administration are still trying to gut what is left of Obamacare–a move that could potentially remove health care from 30 million Americans. And when a vaccine is finally developed and available to the public, there has been no assurances that it will be affordable for all.

Trump also has a history of taking control of the messaging when it comes to science related issues. For instance, the White House has prevented meteorologists from discussing hurricane forecasts, Health and Homeland Security staff from commenting on gun violence after mass shootings, and US Geological Survey scientists from mentioning climate change. (Woodward, 2020) Taking its cue right out of Joseph Stalin's playbook, the Trump administration's attacks on science, which have often been provoked by public crises, have revealed instances where the White House has muzzled representatives entirely, or at the very least required them to remove certain words from reports, or demanded that they both retract and reverse statements from their reports and these include rebukes of the National Weather Service, the National Oceanic and Atmospheric Administration (NOAA), the Department of Agriculture, the US Geological Survey, Centers for Disease Control and Prevention, the Department of Interior and the National Park Service (Woodward, 2020).

There was also an expressed outrage among the public when Trump put anti-science Vice President Mike Pence in charge of the coronavirus threat to the US since the worst HIV outbreak in Indiana's history occurred in 2015 while Pence served as governor of that state. Pence was too slow in declaring a public health emergency and approving needle exchanges (Stroop, 2020). Pence has already erroneously claimed, as has Trump, that a vaccine for Covid-19 will be available in a few months (Rupar, 2020) and he is bragging about increased screenings at US airports without seeming to realize that airport screenings are not the equivalent of laboratory testing (Parton, 2020). However, it has been revealed (a divine revelation?) that Christian nationalist Mike Pence has a weapon that he believes is much more powerful than any remedy, treatment or cure that might be cooked up in a laboratory—even a US laboratory. What on earth could that be? It turns out to be a high-powered White House prayer circle, designated as an official US government task force, and made up of mostly white male conservative Christians armed with scripture and ready to take on the demonic forces of Covid-19. Chrissy Stroop writes

A plague is upon us. And white evangelicals, naturally, are on the scene—theologizing the Covid-19 outbreak, praying, scolding, and generally being counterproductive. Unfortunately, the Trump administration's response is being led by one of them —Vice President Mike Pence, a fellow Hoosier and one who, as governor of Indiana, allowed an HIV outbreak to blow up because his Christian extremist ideology prevented him from adopting sensible policy. There are reasons I've left that state.

While the White House's Christian supremacist coronavirus prayer circle has been mocked by critics, Stroop (2020) is quick to point out that: "people aren't mocking Pence's prayer circle because they're praying, they're mocking it because it reflects a history of substituting prayer for action in situations that require material actions that the praver-givers are powerful enough to take." We feel fortunate that Rick Wiles, a non-denominational senior pastor at Flowing Streams Church in Vero Beach, Florida, who maintains that leftists are planning to execute Christians, and that homosexuals, if given the chance, would attempt to rape angels, was left out of the White House prayer circle. Other evangelicals outside the divine circle are doing enough damage. Pat Robertson told his millions of television viewers that if you have a healthy gut you won't be in danger of falling prey to the coronavirus. Scott Lively claims that the Democrats are intentionally going to try to infect people in order to sink the economy and thereby magnify election problems for Trump. Sean Hannity, one of the most popular radio personalities in the US, and a feral Trump supporter, has put this same message out into the public airwaves through his Fox News state media broadcasts while also claiming that Trump has done more to prevent the spread of the virus than "anybody in modern history." Televangelist Jim Bakker is selling his Silver Solution cure, claiming that it cures the coronavirus virus. It sells for \$115.00 and California law has required him to warn purchasers that it contains chemicals that cause cancer and birth defects.

Clearly, Trump's insistence on politicizing the outbreak and spreading disinformation about the health risks to the wider population has put the public's ability to handle the virus at grave risk. And there are also accusations in the media that Trump's administration is trying to profit financially from the pandemic. According to a Common Dreams report (2020a):

On February 29, the *Post* detailed how Trump's main concern as the potential for a viral outbreak heightened in the U.S. was that he was being treated unfairly by the media, that health officials offering candid assessments of the threat posed by the disease were making him look bad, and that the panic was affecting the stock market. That led to the president downplaying the danger posed by the disease and encouraging conspiracy theories calling the outbreak a "hoax." The *Post* also reported Trump knowingly lied about the disease spread in a press conference in an attempt to soothe markets.

The president has assigned managing the virus to a team of health industry-connected officials who have interests in profiting off of the disease, Sharon Lerner reported for the *Intercept* Saturday, and over the course of his presidency "shut down the National Security Council's global health security unit and cut \$15 billion in national health spending, including funding for the management of infectious global diseases at the CDC, DHS, and HHS." (Common Dreams, 2020a)

As a way of assuring the capitalist class that the central bank was taking Covid-19 seriously and committed to keeping the economy from spiralling out of control, the Federal Reserve cut its interest rate to the lowest rate since the 2008 Recession (that was linked to the subprime mort-gage crisis). And the cuts could keep increasing. Trump is considering the use of natural disaster funds to pay for coronavirus patients who remain uninsured. The US is woefully unprepared at this present moment to handle a pandemic.

Concerned by Trump's public health cuts, presidents and registered nurses Deborah Burger, Zenei Cortez, and Jean Ross of National Nurses United, the largest union for registered nurses in the United States, penned an open letter to Vice President Mike Pence which asserted that, "[a]t the moment, we have a fragmented and broken public health infrastructure which is woefully unprepared for Covid-19" (Common Dreams, 2020b). The letter calls for assurance that a vaccine for the virus will be provided for free to the public and that health care workers will be protected. Initially Trump claimed that the Democrats were creating hysteria surrounding Covid-19 as a means to discredit his presidency. Trump described such tactics as a hoax. Trump seemed to echo the vile remarks by his friend and ideological twin, hate radio impresario Rush Limbaugh (whom Trump recently awarded the Presidential Medal of Freedom) who wrote:

Folks, this coronavirus thing, I want to try to put this in perspective for you. It looks like the coronavirus is being weaponized as yet another element to bring down Donald Trump. Now, I want to tell you the truth about the coronavirus. (interruption) You think I'm wrong about this? You think I'm missing it by saying

that's... (interruption) Yeah, I'm dead right on this. The coronavirus is the common cold, folks. (Limbaugh, 2020)

Limbaugh's comments are more than irresponsible—they could have fatal consequences. Medical experts now caution that Covid-19 appears to be deadlier than the seasonal flu. Thomas Franck reports that as the infections have spread in the US, Trump has begun rejiggering his position that the virus was a hoax. Instead, Trump bragged: "We are magnificently organized with the best professionals in the world." Trump's description of the heroic efforts of his administration to contain the spread of the virus was sheer bloviation (Franck, 2020). Later Trump added the following comments: "We have to take it very, very seriously ... We are preparing for the worst" .... "My administration has taken the most aggressive action in modern history to prevent the spread of this illness in the United States. We are ready. We are ready. Totally ready" (cited in Franck, 2020).

Yet Trump continues to communicate in an information mode marked by a bad messaging ecology, undercutting the seriousness of the situation by politicizing his Democratic opponents and further fracturing the cohesiveness of the country at a time that calls for a unanimity of response: "We will do everything in our power to keep the infection and those carrying the infection from entering our country. We have no choice ... Whether it's the virus we're talking about or many other public health threats, the Democrat policy of open borders is a direct threat to the health and wellbeing of all Americans" (cited in Franck, 2020). Just when the U.S. Centers for Disease Control and Prevention (CDC) was expressing concern about the spread of the virus throughout local communities in the US, Trump pushed back on the CDC's assessment, remarking that he does not believe that community spreading in the US is inevitable. In fact, Trump initially asserted that he's not worried about the spread of the virus in the US. He noted "Because of all we've done, the risk to the American people remains very low." He also opined, "We'll spend whatever is appropriate. Hopefully, we won't have to spend so much because we really think that we've done a great job in keeping it down to a minimum" ... "It is what it is. We're ready for it. We're really prepared. We have, as I said, we have the greatest people in the world. We're very ready for it." (CNN, 2020) Just two years previously, in 2018, Trump closed the United States pandemic office. Beth Cameron, the former Senior Director for Global Health Security and Biodefense on the White House National Security Council (NSC) staff, writes:

When President Trump took office in 2017, the White House's National Security Council Directorate for Global Health Security and Biodefense survived the transition intact. Its mission was the same as when I was asked to lead the office, established after the Ebola epidemic of 2014: to do everything possible within the vast powers and resources of the U.S. government to prepare for the next disease outbreak and prevent it from becoming an epidemic or pandemic.

One year later, I was mystified when the White House dissolved the office, leaving the country less prepared for pandemics like covid-19.

Thus, when the coronavirus appeared, "there was no clear White House-led structure to oversee our response, and we lost valuable time" (Cameron, 2020).

There has been concern expressed that hospitals are not getting the testing kits and that Trump's Centers for Medicare and Medicaid Services have not decided what part of the nearly \$4,000 associated costs of getting tested for the coronavirus would be covered by insurance, putting infected people at risk for staying in the general population without treatment (Common Dreams, 2020b). And, unsurprisingly, Trump was quick to point out that his huge public rallies are free from the coronavirus and that they are "very safe" (Edwards, 2020). This remark is all the more suspicious in light of the fact that the Director of the National Institute of Allergy and Infectious Diseases, Anthony Fauci, who has steered the country through the AIDS and Ebola epidemics, has been silenced by the Trump White House. Fauci can only speak about the virus with prior approval and clearance from the White House (Shear & Haberman, 2020).

As it stands, there is no federal regulation to protect those millions of Americans who have jobs that put them at a higher risk of coming in contact with airborne infection diseases such as Covid-19. The Occupational Safety and Health Administration does have a standard for protecting workers from bloodborne pathogens, but as OSHA notes, that regulation "typically [does] not include respiratory secretions that may transmit Covid-19" (Jamieson, 2020). As Jamieson notes,

[t]he Trump administration has been far more likely to repeal regulations on employers rather than add new ones, and the president has worked hard to downplay concerns over coronavirus as the stock markets plunged. He has lowballed the number of infections as they have become public, and said the virus will probably "go away" in the spring, even though experts aren't sure that will happen. (Jamieson, 2020)

But we can always rely on administration officials to offer sound, commonsense advice.

Dr. Sara Cody, health officer and director of the Santa Clara County Public Health Department, recently offered advice on how people can stop the novel coronavirus from spreading:

"Today, start working on not touching your face because one main way viruses spread is when you touch your own mouth, nose, or eyes," Cody, director of the Santa Clara County's Public Health Department said at the Friday press conference.

Less than a minute later, Cody brought her hand to her mouth and licked her finger to turn a page in her notes. (Hernandez, 2020).

Some good news has emerged on the horizon—a funding package passed by the Senate and on its way to Congress. Yet even here there are political antics galore. When reviewing the \$8 billion bipartisan funding package for the coronavirus, court jester and Trump lackey Rep. Matt Gaetz (R-FL) mocked the whole process by wearing a gas mask.

Clearly we are living in the bowels of Foucault's disciplined society, ever in search of that fictitious pure community that can only be imagined by viralized groups such as those currently ensepulchered in globally pandemicized plague towns filled with the sights and sounds of hacking coughs, bloody phlegm and the sloppy lotion squeaking from hand sanitizer stalls running out of antibacterial refills. Yet there are those who are attempting to exclude potential carriers of the virus from the incipient plague towns of Europe and North America through an increase of street assaults on Asians bystanders (Yan et al., 2020; Guy, 2020).

#### Postscript (Michael Peters, Petar Jandrić, and Peter McLaren)

Utilising aspects of a viral-digital philosophy we have outlined a concept of bioinformationalism that trades on earlier work in postdigital studies to engage with the history of epidemics and the institutional response to Covid-19 or Coronavirus. At the beginning of March 2020, the world has passed through the early stages of the pandemic, based on one of seven human strands of a virus that started in the city of Wuhan and spread within China killing more than 2,500 people, and threatening the rest of the world where currently numbers contracting the virus are greater than within China. Bioinformationalism is a concept that allows us to observe parallels between viral forms in biology and information and to differentiate between good and bad ideas, as in open science, that develops a virtuous exchange and sharing of ideas, and fake news that propagates error and falsehood through conspiracy theories based on generating fear as a means of control and domination.

We have written this article in the early days of the Covid-19 outbreak. While we developed our viral-digital philosophy, analysed success and limits of open science, and waited for our open reviews, on March 11 the World Health Organisation "declared Covid-19 a pandemic, pointing to the over 118,000 cases of the coronavirus illness in over 110 countries and territories around the world and the sustained risk of further global spread" (Ducharme, 2020). Writing from New Zealand, Croatia, and the U.S., we have suffered different levels of exposure (at the moment of writing, one of us has just started a two-week self-isolation) and witness different governmental responses. Another one of us who teaches in the US has seen visiting scholars he has brought to his university from China just prior to the outbreak of the virus, seek early passage back to China where the likelihood of infection now appears much less than in the US. China, where the Covid-19 pandemic started, has immediately introduced harsh measures such as complete closure of multi-million cities and already reports a decline in number of newly infected people. Europe and the U.S. have been much slower to respond, and on March 13, "[i]nternational health officials said Friday that Europe has become the epicenter of the coronavirus pandemic, as the continent is now producing more new cases each day than China did at the height of its crisis" (Coote & Jacobson, 2020). As we write these words, European countries have now finally implemented vigorous measures including closing borders, schools, etc. while the U.S., acting even later, has declared a 'national emergency' that provide emergency powers. These varied responses reflect differences between political regimes, ideologies, and ways in which societies are organised. However, conceived in our viral modernity characterised by "multidirectional flows of people, objects, places and information as well as the structures they encounter and create that are barriers to, or expedite, those flows" (Ritzer, 2010: 2), the Covid-19 pandemic is a sobering reminder of unity of the whole humankind.

Based on recent overlay data from China and South Korea, it is likely that the Covid-19 pandemic in the West will last at least for 3–4 months (say June-July 2020), even with rigorous and systematic testing. The real global health crisis will occur when the virus makes inroads into developing countries that do not have the health infrastructure or testing regime to deal with the virus and generally with poorer hygiene and public education. The infodemic effects are likely to be even greater during this time with damage to the infosphere, including international education and education at home. The ongoing economic and social effects will be disastrous and this provides an anti-globalisation experiment when countries suspend travel and close their borders at exactly the point when the free exchange of scientific and public information is absolutely vital. Our current conjuncture requires emergency plans, sober media reporting, handwashing instructions, and a myriad of other measures that might help humanity to defend from Covid-19. While we engage in all these measures, it is hugely important to also step back and take a birds-eye, *longue durée* view at current events. Written in the early days of the Covid-19 pandemic, this article lays some foundations for this work that will surely be continued in many years to come.

#### **Open review 1: Biopolitics and education (Liz Jackson)**

Peters, Jandrić, and McLaren's article, 'Viral Modernity? Epidemics, Infodemics, and the 'Bioinformational' Paradigm' explores some of the most important issues we now face. 'Infodemics', 'bioinformation', and 'viral modernity' are not commonly discussed as such. Yet as the authors illustrate, understanding these complex forces from historical and political perspectives is key in examining the much more topical Covid-19 epidemic. The article thus does a valuable service by tying together these and other complex themes, showing how bioinformation, modernity, concepts of virus and quarantine, and post-truth politics blend in a poisonous public stew in this case. This is particularly seen in the acts and words of Donald Trump and Mike Pence. As the article demonstrates, these politicians engage in biopolitics, but manipulating Covid-19 for their own partisan ends, within a post-truth landscape of power grabbing that hardly respects open science, a form of knowledge socialism marked by openness and peer review (Peters et al., 2018; Peters, 2019). Thus, the article does an excellent job covering a range of topics substantively and analytically.

In the rest of this review I would like to consider the importance of informal education in relation to biopolitics, public health management, and bioinformationalism in this case. While Trump and Pence advocate nationalism, and white and Christian supremacy in their response to Covid-

19, conditions of viral modernity and post-truth enable their dilution of messages from open science, establishing and exacerbating uncertainty, and mass public and political vulnerability. In particular, by doubting and rejecting World Health Organization guidelines, Trump and his associates bolster one aspect of viral modernity, as the loudest voice in the room wins, over knowledge from open science. In place of facts about Covid-19, mainstream media in the United States echoes gossip, such as that association with China or Chinese people is essential for contracting Covid-19, while the virus can also apparently travel long distances by itself on postal packages. These ideas stigmatize and scapegoat people of Chinese ethnicity, who now face serious harms related to harassment, while also increasing mass panic and uncertainty (Jackson, 2020). Instead of sharing public information about Covid-19 developed on the principles of open science, social media provides an echo chamber of individual postings of anecdotal insights, for example of what one scientist who worked in China says about Covid-19. Such sharing, bolstered by viral social media functions, again dilutes information, obscuring, complicating, and sometimes contradicting better sources.

In this context, Peters, Jandrić, and McLaren provide a tremendous service by entering their discussion in the sphere of educational philosophy, highlighting how education is interconnected with knowledge and politics in such cases. I hope this article invites more conversation on viral modernity, bioinformation and more in education in the future.

#### Open review 2: Re-thinking collective viral modernity (Marek Tesar)

Covid-19 has quickly become the new code for being and living in the world as connected human subjects. The paper has highlighted these notions and tensions, and this is a timely and important contribution to the scholarship and where we are at as both scholars and human beings in 2020. It is important to debate and see this paper in relation to what this means to be an academic in 2020, with events, meetings, visiting lectureship and conferences getting cancelled. We have entered into 2020 with an interesting experience, which this paper has discussed and debated powerfully and in depth via concepts such as viral modernity and bioinformationalism. There are three areas that I would like to further build on and mention in order to show how viral modernity may operate and exist in scholarly world of 2020.

I am intrigued by the notion of generosity in academia in relationship to wellbeing. We have already problematised wellbeing in the past (Tesar & Peters, 2019), however Covid-19 has brought to us new ideas and experiences what this may mean and how it may be performed. What we have witnessed are academics not willing to travel to conference not in order to protect themselves, but to protect those with lower immune systems and more prone towards respiratory illnesses. This act of care is much needed by individuals, and is linked to care and being with the collective, as Peters et al. (2016) have pushed in the collective ecology of writing. This is an antidote to the private individualistic hording of resources in the time where panic (exemplified by media) is reaching out to everyone on this planet.

The second point is about the notion of technology in Covid-19 outbreaks. The article refers to the 'collective body of technology' that has been powerful in the way it helps us to understand how technology operates and works. Meetings have moved online. Conferences are offering synchronous and asynchronous sessions instead of the traditional face to face. Academics who for past decades have been forced by administration to try and utilize online mechanisms in teaching to increase enrolments and often to enable cost cutting are now being asked to prepare to use these technologies to keep teaching and learning going in the event of a university shutdown. However, perhaps because of Covid-19, we have witnessed a collective intelligence of technology (Peters & Jandrić, 2018); where the technology started to serve as both towards stopping the spread (and fake news), and to enable staying connected and continue the academic work of connection and dissemination.

The final point for me from this important paper is perhaps the most important one. The idea of connectedness while being isolated. We are all connected, and no longer can ideology or geographical borders contain a virus (or the idea of a virus). The planetary outlook will perhaps allow us to rethink how we are positioned in the world; where the human subject stands; what is the future of mankind. In some countries we have been advised not to kiss dogs in order to stop the spread of the virus. We were asked to perform social distancing. Yet, we have never been more connected; both as academics, as people; as a planet with all human and non-human entities. As this paper reminds us, it is indeed a 'viral modernity'.

#### The virus as Pharmakon (Sean Sturm)

The topic of this essay, viral modernity, or the nexus signalled by the homology of computer and biological viruses, is timely. It argues, in a hyperbole so outrageous that it just might be true, that the global plague of misinformation that has been unleashed by the coronavirus pandemic (not least Donald Trump's accusation that it is "fake news") is what Paul Virilio (2007) would call the "integral accident," or disaster that is characteristic, of the technology of bioinformatics.<sup>8</sup> To say that every technology has its integral accident is another way of saying that technology is a *pharmakon* (Derrida, 1981): a cure that can harm its patient – as writing was for Plato and technoscience might be for us (Stiegler, 2012; 2016). (I would note that, in the original Latin, a virus is a potion or a poison – and, in the case of technoscience, that, while some of us drank the purple Kool-Aid willingly, most of us are being force-fed it.) Moreover, the essay also alerts us – via Bateson (1972) and Guattari's (1989) post-Cartesian ecologism – to the "intrusion of Gaia" (Stengers, 2017), that is to say, to the recalcitrance of the Earth to humans' embrace of the Anthropocene and the technoscientific solutionism it too often is taken to imply. But its analysis of viral modernity stops short of offering prompts for the kind of collective and transversal experimentation that we - and we scholars - need to reclaim our capacity for what Isabelle Stengers (2017: 391) calls "autonomous consensus" (viz., non-majoritarian "sensing-together").

What are we scholars to do in the face of Gaia, who - like Schiller's (2011/1795) figure of Truth – masks herself in "fake news" and ever "biggerer" data? First, we need an epistemology that allows us to see at scale because "seeing like a system" (Gershon, 2005), as many scientists and some "humanitarians" are learning to do from ecologists, is not enough. Seeing at scale involves learning what we cannot control (the Earth) and what we can do (experiment together). In the case of the specific problem that the essay raises – what the editors of scholarly journals are to do in the face of "fake news" about coronavirus – the tried and true solutions won't work. Critique, like fact-checking, won't work because it tends to rely on a positivist and Cartesian understanding of truth as correspondence with the facts people know for certain. (Trump doesn't care about facts or people because everything is relative to him.) Global solutions, like teaching Al through large datasets, won't work either because they rely on anthropocentric algorithms to extrapolate from what we already know to what we don't. (Proving Trump wrong proves him right because that's exactly what the "fake news media" would do.) Both solutions exhibit a human hubris that prevents us from learning what we cannot control. So what are we to do? In short, we learn to experiment – and, in in doing so, to wrest scholarship from capitalism. As Stengers (2015: 53) puts it, "Struggling with Gaia makes no sense – it is a matter of learning to compose with her. Composing with capitalism makes no sense - it is a matter of struggling against its stranglehold." When it comes to scholarly journals, learning to experiment – to compose with Gaia – means paying attention to collective and transversal techniques like editorial collectives, open review, collective writing and multimodal writing that allow us, in Stengers' phrase, to "sense together" and work to (re)claim a commons that is "more-than-human" (Bresnihan, 2015).

#### Notes

- 1. During the largest part of history, people did not distinguish between illnesses caused by viruses and bacteria.
- See https://gisanddata.maps.arcgis.com/apps/opsdashboard/index.html#/bda7594740fd40299423467b48e9ecf6? utm\_source=sn&utm\_medium=referral&utm\_content=null&utm\_campaign=BSLB\_1\_CA01\_GL\_BSLB\_AWA\_ CA01\_GL\_LSGR\_PubH\_Coronovirus\_LandingPage.
- 3. See https://www.who.int/emergencies/diseases/novel-coronavirus-2019.
- 4. See https://github.com/CSSEGISandData/Covid-19.
- 5. See https://scholar.google.com/.
- 6. See https://www.webofknowledge.com/.
- 7. On 28 February 2020.
- 8. The essay neatly brings together what Žižek (2009: 53) called the four "antagonisms" confronting global capitalism: "the looming threat of ecological catastrophe; the inappropriateness of private property for so-called intellectual property; the socio-ethical implications of new technoscientific developments, especially in biogenetics; and last, but not least, new forms of social apartheid new walls and slums."

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