A VIROCENTRIC PERSPECTIVE ON EVIL

by Mirjam Schilling

Abstract. The coronavirus pandemic has stirred interest in viruses. This has been accompanied by a proliferation of popular works trying to explain how viruses fit into the Christian worldview. In an anthropocentric perspective, viruses are easily regarded as malicious entities. This article, however, shows that a proper understanding of the biology of viruses actually adds another level of complexity to our perception of good and evil. Interestingly, this additional layer of complexity might help us solve some of the most urgent difficulties in the discussion about good and evil, if we recognize the subjective nature of what we call natural evil. We need to be more nuanced not merely in our theological discussion about good and evil, but also in the way we talk about viruses.

Keywords: COVID-19; Ebola; evil; HIV; Influenza A; pandemic; SARS-CoV-2; sin; the only way argument; virus

Introduction

The 2020 coronavirus crisis rapidly raised our awareness of viruses and the potential threat they harbor. This resulted not only in a fresh medical and political, but also theological examination of the topic. Publications on the topic include "Where is God in a Coronavirus world?" by John Lennox (Lennox 2020) and "God and the Pandemic" by N.T. Wright (Wright 2020).

In response to COVID-19, Justin Welby, Archbishop of Canterbury, declared the coronavirus "unmitigated evil: It destroys life, families, jobs, people's capacities to intermingle and to live normal lives" (Welby 2020). This raises two questions: What do we understand as evil? and Does this understanding justify calling a virus evil?

I am a research scientist in the field of virology with a strong theological background. The current debate naturally sparked my interest.

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Technologies such as high-resolution microscopy and high-throughput sequencing have substantially increased our scientific understanding of viruses since they were discovered as pathogens in the late nineteenth century. We are now only starting to estimate the dimension of the virosphere and how its diversity shapes us and the world around us as we know it. From an anthropocentric perspective, viruses are commonly seen as malicious entities. In the following, I compare our biological knowledge of viruses with some main current theological ideas about good and evil, to question our intuitive perception of viruses and evil.

Moral Evil and Natural Evil

The problem of evil is complex. It is therefore important to clearly define what we mean by evil. Our understanding of evil ultimately shapes our reflections on suffering, redemption, and salvation. The first distinction I want to draw on in this essay is between *moral* evil and *natural* evil. Moral evil is a category of evil that is linked to human behavior and free decisions. It is beyond the scope of this article to fully explore the theological approaches of moral evil, but we will come back to the impact of human decisions on viral spread later. Natural evil includes all aspect of nature that cause suffering or differ from a perfect state of this world. The definition of the latter is problematic in itself because it again depends on prior assumptions.

Some have thought of viruses as one means by which humans are punished by God, as a consequence of their moral sin. Several news headlines this year have asked, "Is coronavirus a judgment from God?" (Schnell 2020; Sharon 2020). Similar questions were raised for earlier pandemics such as Ebola or HIV/AIDS (Murphy 1988; Anonymous 2014; Olaore and Olaore 2014). This is not a modern phenomenon. For example, similar thoughts have already been documented in sermons during the plague in the seventeenth century (Davies 1720).

Declaring virus infection as consequence of moral evil is nevertheless difficult. Although the Old and the New Testament suggest that disease or death are a divine way to punish disobedience, other biblical accounts suggest a more nuanced perspective on the topic of disease. There are cases in which God allows suffering when people have done nothing wrong.[1] Admittedly, there is a component of human behavior that influences the course of a virus infection. In case of the 2020 SARS-CoV-2 pandemic, reduced globalization or a different approach to animal markets would have dramatically reduced viral transmission. Human decision and lifestyle choices also clearly have an impact on the spread of other viruses, including HIV-1 or human papillomavirus. However, all of these can at best be named risk factors. None of these human decisions or behaviors can cause the existence of a virus in the first place.

Independent of personal faith or religious affiliation, viral infections cause the suffering, disability, and death of millions of people every year. Although the development of effective vaccines has dramatically reduced the amount and severity of many pathogens, such as measles or poliovirus, newly emerging virus outbreaks remind us of the threat they pose. The seasonal influenza A virus, which is presumed to be relatively innocuous, causes 200,000 to 600,000 deaths each year. Other dramatic outbreaks such as the Spanish Flu in 1918, Ebola virus in 2014, Zika virus in 2015, or the SARS-CoV-2 in 2019 will long be remembered. Besides acute infections, viruses also cause chronic infections, such as hepatitis B and C viruses, herpesviruses, or HIV. Some of these chronic infections can lead to the development of cancer.

At first glance, categorizing viruses as natural evil therefore seems logical. Yet it is important to appreciate that our simplified narrative encourages us to think that the disease is solely caused by the virus. Undeniably, without the virus the disease would not develop. Nevertheless, the story is more complex than that. Many of the symptoms we experience are actually caused by the way our immune system reacts to the virus (Rouse and Sehrawat 2010). The runny nose, fever, coughing, sneezing, and even muscle pain during an infection with influenza A virus, for example, are mainly results of an active immune response. Cytokines, a category of signaling molecules that activate and regulate immune responses, or attracted immune cells can have damaging side effects during acute and, especially, chronic viral infections (Trinchieri 2010,; Murira and Lamarre 2016). Differences in immune responses between the biological sexes can increase the risk for men to suffer more severely from COVID-19 (Scully et al. 2020). Immune responses need to be tightly regulated and often determine the outcome of a disease for individual patients. Therefore, treatment options always have to consider the role of immune responses. Accordingly, one of the three pillars of antiviral treatments is actually not antiviral, but immunomodulatory, and treatment with interferons during chronic virus infection such as hepatitis C virus must be carefully measured. The effect of overactive immune responses can be observed not only in infectious disease but also in cancer patients or people suffering from autoimmune diseases. As a proof of principle, similar viruses that cause dramatic pandemics and severe disease in humans replicate almost unnoticed in bats. Bat cells induce less pro-inflammatory responses while mounting an antiviral response against viruses. This may be one of the reasons why they can harbor a larger virus reservoir without succumbing to it (Zhang et al. 2013; Ahn et al. 2016; Banerjee et al. 2017).

Attributing a disease solely to the virus is an oversimplification of what is actually happening. If we therefore want to declare viruses as natural evil, we must acknowledge that an essential attribute that makes them evil (for humans) is our own vulnerability, caused by our own immune response.

The Reason for and Beginning of Evil

Another level of difficulty arises when we look at the different theological approaches to answer the question where evil comes from and why it is there.

One common approach argues that the existence of evil is a consequence of human freedom. To allow human beings to make their own decisions, God self-limited his power and allowed there to be an alternative option, evil. As a consequence of the first humans' choices evil came into this world, a cosmic Fall, while the biblical claim of a loving God who created a world that he declared as "very good" is maintained. "Free-process" arguments assume that the evil was created by God himself as part of the evolutionary process that allows ecosystems and different species to develop freely. Advocates of this type of argument admit the ambiguity of the system but believe that the good of the freedom within the process outweighs the suffering caused by it. The natural process of adaptation of creatures to their environment enables theologians to distance a good God from the details of the process. One scientist-theologian who advocated this "kenotic theology" of creation is John Polkinghorne (1996, 45–46).[2] The "only way argument" in turn acknowledges that the disvalues we are mourning and the values we are celebrating are actually developing though the same process. Both, values and disvalues, come as some sort of "package deal." Without the disvalues, the biological values we see would not have come into being. This approach acknowledges the drama of suffering for the whole of creation through the evolutionary process, but proposes that this process nevertheless was the only—or best—way that enabled to have truly free creatures (free-process and only-way arguments are reviewed in Southgate 2018). A famous advocate for this concept is Arthur Peacocke (1993). Objections against the only way argument are concerned with the fact that this process is intrinsically violent and seems to contradict God's goodness and his declaration of creation being "very good" in Genesis 1:31.[3] Christopher Southgate furthermore questions whether the freedom of the process is sufficient to outweigh the suffering, and suggests that maybe the values that result from the freedom of process might outweigh the suffering. These include values such as consciousness and intelligence, which would have enabled individuality and the flourishing of the individual creature (Southgate 2008). He also added that the "only way" argument is an essential starting point for the discussion but has its limitations. It therefore needs to be combined with other elements, such as an eschatological compound or the idea of divine co-suffering, as already proposed by Arthur Peacocke (Southgate 2018). Southgate (2008) calls his approach "compound theodicy" (15–16). Bethany Sollereder integrated these approaches with thoughts about the unifying character of redemption in the global suffering (Sollereder 2016; 2019, 156–78).

Critics of this approach question whether an evolutionary process with suffering would have really been necessary to create creatures with a free will. One example of such criticism is Mats Wahlberg's thought experiment of an ex nihilo created doppelganger (Wahlberg 2015).[4] An in-depth analysis of these arguments and the necessity of suffering is beyond the scope of this article, and their relation to viruses will have to be investigated in a separate article.

These approaches that try to reconcile biological findings and biblical descriptions of a loving God are based on a careful re-assessment of theologies of the Fall. Some theologians such as John J. Bimson believe that a cosmic fall in which Adam and Eve's fall impacted the whole of creation is hardly reconcilable with Scripture at all (Bimson 2006). Bimson refers to the uncertainties in the interpretation of key passages within the Old and New Testament that are often used to support a cosmic Fall that preceded the human Fall. In reference to Colossians 1:20, he, for example, comes to the conclusion that it is "exceedingly precarious to use it to support the doctrine of a cosmic fall."[5] From the perspective of virus research, viruses are thought to have been around much longer than any living creature. Based on the findings that viruses infecting cells from all three domains of life (Bacteria, Eukarya, and Archaea) are evolutionary related, or that there is a plethora of viral proteins without homologues in eukaryotic cells, many theories about the origin of viruses assume that viruses existed even before single-cell organisms, not to speak of more complex multicellular organisms such as human beings (Koonin, Senkevich, and Dolja 2006; Forterre 2006). Viruses are therefore assumed to have majorly contributed to the development of cells and multicellular organisms, potentially even the establishment of DNA genomes, while evolving into the large variety of viruses we now observe. If we declare them as natural evil, we cannot declare this natural evil as a result of a Fall that resulted from human behavior. We cannot declare them as evil that resulted from a rebellion of any living creature.

Biological findings would therefore only be reconcilable with the scenario of a cosmic Fall that predated the moral fall of humans. Theologically, this corrupted state is regarded to be either the result of a conscious rebellion of angels as advocated for by Michael Lloyd (2018), or caused by some mysterious influence (Deane-Drummond 2018; Hoggard Creegan 2018; Messer 2018). The advantage of this approach is that it would uphold the notion of an all-loving God. One of the main theological problems with this is that a pre-human fall is not formally described in Scripture, although some would argue that the existence of the serpent in the garden can serve as evidence. There is furthermore no biblical evidence that an angelic fall is accountable for a corrupted world. On the contrary, after the whole description of creation and the arrival of complex multicellular organisms, the world is described as "very good" (Genesis 1:31,

NRSV). Another problem with this approach is that if we assume viruses are the evil that resulted from a pre-human Fall, this would mean that in an evolutionary model all living creatures therefore necessarily developed through evil.

Creationists propose that there might have been a difference between the character of viruses before and after the Fall. In a prelapsarian state, "it is possible that God made viruses as tiny robots to carry life-enhancing genetic information from one cell to another. At some point after the Fall, the once-balanced cell-virus interactions would have begun to falter and fail" (Thomas 2011; French 2020). Bryan Thomas, science writer at the Institute of Creation Research further argues, "Viral machinery is exploited by man for gene therapy. If man can use viruses to accomplish a good purpose, then so can God."

To respond to this argument, we need to understand what exactly viruses are and how they work. Viruses are self-replicating entities that are generally defined as nonliving. They consist of genetic material that is packaged by a couple of proteins and usually a lipid envelope. As a consequence, they are obligate intracellular pathogens. This means that the genetic material carries instructions of how to produce more viral particles. However, to produce these particles, they need a host and its machinery. Different virus families have very different strategies that allow them to hijack the cellular machinery, but the consequences are the same: Host cells copy their genetic material and produce all the building blocks for new virus particles. These then assemble and build many new infectious entities that will go through the same cycle in a different cell. Viruses are indeed a very useful tool to deliver genetic information into cells, and they are therefore widely used in biomedical research as well as for vaccines and gene therapy. In the current antibiotic crisis, for example, bacteriophages are currently explored as alternative antibacterial strategies (Schroven, Aertsen, and Lavigne 2020). Nevertheless, it is very difficult to have the benefits of a virus without its disadvantages. A self-replicating entity is by definition hard to control. Another problem is that of the immune responses we have discussed earlier. The pathogenicity of a virus is determined by both virus and host immune system. An immune response that is strong enough the clear the pathogen comes with the risk of more or less severe tissue damage. A weak immune response will always run the risk of not being able to eliminate the pathogen.

Therefore, "the only way argument" probably reflects the current biological findings better. Research on the origin of viruses is only at its very beginning, but, as mentioned earlier, currently points to a scenario where viruses began as small replicating units and got more complex by acquiring sequences/proteins from other domains of life. Krupovic et al. propose, "The replication machinery arose from a primordial pool of

genetic elements, whereas the structural proteins were acquired from hosts at different stages of evolution" (Krupovic, Dolja, and Koonin 2019).[6] This scenario suggests that virus-host coevolution is one key factor, if not the key factor, that drives the evolution of both cells and viruses (Koonin and Dolja 2013). In this scenario, primitive replicator systems were essential for the major evolutionary transitions such as the emergence of DNA genomes, cellular organization and the development of the eukaryotic cell (Forterre 2006; Koonin, Senkevich, and Dolja 2006).

In terms of our reflection on the complexity of good and evil, this means that simply declaring viruses to be "evil" cannot be sustained by virological research. We have to at least consider that they may fall into the same category as tectonic plates and volcanoes, constituents of the nonliving world that are necessary for the development of the earth as we know it, but are accompanied by suffering (White 2014).

The Anthropocentric Problem

In the second half of this article I will further explore this thought and point out why our current anthropocentric perspective on viruses causes problems for our debate on good and evil, as well as the opportunity a virocentric perspective can offer us.

The first problem we encounter was already obvious in the description of viral replication in the previous paragraph: Our vocabulary emphasizes the subjective perspective we have on viruses. We are humanizing them, expecting them to have a motivation and a will when we say, for example, that they hijack host cells. This is not a problem specific to theology. This misrepresentation emerges from the field of virology through the way we discovered viruses, namely as parasites. With the development of better technologies, further details of viral mechanisms were uncovered. Novel sequencing techniques and metagenomics are beginning to show us the extent to which the world around us is infected by viruses. All cellular organisms, with the possible exception of some intracellular parasitic bacteria, harbor unique repertoires of viruses (Krupovic, Dolja, and Koonin 2019). We can only estimate the wide range of viruses and how they are intertwined with every process in our ecosystem. Unfortunately, our anthropomorphic vocabulary developed before we could estimate the big picture.

We must be aware of our language when we talk about viruses and how it makes us humanize them, lowering the threshold of assigning human features to them. The opportunity for us here is that viruses urge us to reflect more deeply about the separate categories of natural and moral evil. We need to be aware of the risk of mixing these categories up, especially when it comes to viruses.

Viruses Are Not Always Evil

Humans have a very subjective perspective on evil. In the aforementioned classification of evil as natural evil, we already acknowledged some beneficial aspects of the things we declare as evil, such as the necessity of volcanoes for life despite their disastrous impact in the form of outbreaks and tsunamis. Sollereder (2018) suggests, "The natural sciences can offer helpful tools for theological reappraisal. For example, in the case of natural disasters such as earthquakes, the geological knowledge that plate tectonics are essential to a life-bearing planet can reduce the sense that a natural disaster is the result of divine punishment or caprice. Knowledge of this sort can help develop personal theodicies that serve as anchors for spiritual care providers in traumatic situations. These personal theodicies can then be discussed in time and context-sensitive ways with those who are traumatized".

In the case of viruses, the natural sciences point us to an even more severe difficulty: subjective human judgment. What do I mean with this? When we are talking about nature, and evil within nature, the judgment whether something is good or evil will vary depending on our human perspective, how we as humans are affected.

How does our perspective change when we think about viruses and other species? Viruses cause humans harm in a minority of cases. They are involved in more processes than we could have ever imagined. Viruses and virus-like elements are the most abundant biological entities on Earth, and it is estimated that the number of virus particles in many environments is exceeding the number of cells by one to two orders of magnitude (Koonin and Dolja 2013).

A closer look at different ecosystems shows how the world is shaped by viruses. Most of us are aware that ecosystems affect viruses. We know that population density does affect the spread of a virus or that global warming, with migration of mosquito species, will be accompanied by migration of certain viruses. By contrast, we are mostly unaware of the way viruses influence the dynamics within ecosystems. In many cases, virus infections can cause a change of behavior in the host (e.g., humans). To cite two examples, Bewick's swans infected with low-pathogenic influenza a virus changed their feeding rates and migration, and zebra fish infected with the spring viremia of carp virus changed their thermal preference by 3 °C to clear the virus (French and Holmes 2019). Other examples can be taken from ants. The invasive fire ant infected with *Solenopsis invicta* virus 1 displays reduced foraging performance and changed dietary requirements to carbohydrate-rich foods (Hsu et al. 2018). These changes will in turn impact their environment.

The emergence of new viruses can also lead to ecosystems shifting to alternative stable states suggesting that the "normal" we think of might

not be the original state or the only one with the optimal conditions. For example, the Pan-African rinderpest pandemic caused by a paramyxovirus in the 1890s led to a reduction in wildebeest and buffalo populations in Tanzania. The reduced grazing pressure led to an increase in fires that suppressed the establishment of trees and changed the ecosystem from a woodland state to an alternative, stable, grassland state. After a vaccination program eradicated the rinderpest the ecosystem reverted back to a woodland state (Dobson 2009). Of course, there is no denial that viral infections can have devastating effects on an individual species, but their loss could be another species' gain, and we need to be aware of the fact that our judgment will always be a subjective one. Clearly, more research needs to be done on the influence of viruses on ecosystems in the future, but the current data already suggest that viruses can be a major player to keep populations at the right size, not allowing predators to take over and thereby avoiding eradication of species and stabilizing of food webs. French and Holmes even suggest that viruses could be a good tool to analyze ecological events since "their rapid evolution makes them a powerful marker for tracking short-term processes" (French and Holmes 2019).

Another contribution of viruses is the way virus-mediated lysis of living organisms makes nutrients accessible for the wider community. Some viruses actively induce the disruption of cellular membranes, which consecutively leads to cell death and the release of cytoplasmic content. Famous examples can be found in marine biology, where viruses impact bacteria communities and the marine food web (Suttle 2005; Short 2012). Cell lysis through viruses increases the availability of a variety of nutrients, which can fill a major portion of the requirements of other organisms. Furthermore, viruses are a key player in converting lysed cells into particulate organic carbon and dissolved organic carbon, thereby reducing the rate at which carbon sinks from the surface layer into the deep ocean, where the carbon would be trapped for millennia. Effectively, this builds up CO_2 in the atmosphere in a faster rate. Findings by Emerson et al. (2018) further suggest that viral infection dynamics may differentially impact microbial responses to a changing climate and the release of methane and carbon dioxide from soil.

These examples are in line with Wahlberg, who despite his criticism of the "only way argument," acknowledges, "A more peaceful world would presumably be more static in the sense that selection pressures would be lower and the process of evolution therefore slower." This might support Southgate's (2008) approach in which "an evolving creation was the only way in which God could give rise to the sort of beauty, diversity, sentience, and sophistication of creatures that the biosphere now contains" (16). The opportunity for us in our examination of viruses lies in the recognition that what we declare as natural evil is always a subjective description and is dependent on an anthropocentric world view.

Viruses Are Not Always Evil for Us

As we have seen, we tend to judge whether something is good or evil by determining how it relates to us as humans. The problem with viruses is that, besides influencing whole ecosystems, they are responsible for shaping us as humans. Viruses are suspected to be a dominant driver of protein adaptation (Enard et al. 2016). This means that viruses shape the amino acid sequences of cellular proteins as these try to avoid or limit infection. Since viruses depend on cellular functions for their replication cycle, mutations in essential proteins allow human cells to evade a productive infection. This is true both for proteins that are directly antiviral and for those which play key functions in basic cellular processes, such as transcription or signal transduction.[7] Data presented by Enard et al. (2016) suggest that viruses appear to drive approximately 30% of all adaptive amino acid changes in the conserved part of the human proteome. Viruses (possibly together with other pathogens) might be the key driver of many pleiotropic effects on diverse biological functions in mammals through a very powerful selective pressure.

Surprisingly, viruses not only represent a major evolutionary pressure that forced us to develop into who we are, but have also contributed genetic novelty (Johnson 2019). This includes unique protein-coding genes as well as regulatory elements that are involved in essential physiological functions of the human body. One famous example where a viral gene has been utilized by human cells and now fulfills a critical function is the case of syncytin. This human protein shows a significant similarity to many retroviral envelope proteins, in particular to the env proteins encoded by the human endogenous retrovirus, HERV-W2 (Mi et al. 2000). Experimental data suggest that syncytin may mediate cell fusion in the placenta in vivo, and thus plays an important role in human placental morphogenesis. Syncytin is not an exception. A large proportion (about 40%) of the human genome consists of retrotransposed sequences, and around 8% of the human genome is made up by endogenous retroviruses such as HERV-W. These integrated DNA relics from retroviral infections affected mammalian ancestors for at least 100 million years (Mager and Stoye 2015). Exogenous retroviruses, now mostly gone extinct, infected germ line cells, resulting in stably inherited proviruses in our genomes. More research is needed to understand the effects of these and to unravel their role in health and disease. A recent report suggested that relics from retroviral infections could not only function as single regulatory elements within our genome but might have shaped the evolution of a transcriptional network underlying the interferon (IFN) response, which is a major branch of innate immunity (Chuong, Elde, and Feschotte 2016).

Besides these integrated viral genomes, research has also reported cases in which one virus infection positively modulates our response towards

another. Although coinfections are rarely an advantage and infection with the human cytomegalovirus (CMV) can cause dramatic problems, it was reported that people who are chronically infected with CMV (this is around 40% of people in the Western World and up to 80% in the rest of the world) show stronger immune responses against influenza A infection and might be protected better (Furman et al. 2015).

Overall, even within an anthropocentric world-view our judgment of good and evil is highly subjective and strongly depends on a situation-dependent perception of usefulness, and it might often be dictated by short-term instead of long-term thinking. Here again we must recognize the subjectivity in which we judge the natural world around us. This subjectivity in our judgment might also cause interpretative problems later, when it comes to discerning its relationship to suffering and atonement.

A Virocentric Opportunity

Taken together I show that the interplay between viruses and our immune system in the context of the wider ecosystem we live in is complex.

Overall, I argue that a deeper understanding of viruses offers us a new perspective on the complexity of good and evil. A virocentric[8] perspective on good and evil allows us to see that there is a subjective nature of natural evil that we need to be more aware of when we discuss it. Our personal or human perception of natural evil strongly influences debates about suffering and the character of God, and we are responsible for leading these debates in a nuanced way, in responsibility before God, and for the sake of people around us for whom we have pastoral responsibilities. The virocentric perspective furthermore shows that we need to be more aware of our personal limitations, in terms of knowledge and judgment, and that a sense of humility is highly advisable when it comes to the big questions in life. Additionally, I want to raise the question whether this subjectivity distinguishes natural and moral evil. What if there is no objective good and evil for what we call natural evil, in contrast to moral evil? I appreciate the subjective component of defining moral evil. But what if this difficulty is only due to our human limitations but not due to a lack of objective framework? Or do we even need to sub-divide moral evil into ethical evil and spiritual evil to distinguish between behavioral aspects that only affect areas of moral decisions that are not covered by divine standards? And what do we do with evil that covers both natural and moral evil? Or both ethical and spiritual evil?

Viruses in theology, but also in the wider public, are generally perceived as malicious. This is not surprising. Nonetheless, the biology of virus has more to offer than this, and we should feel responsible to talk about viruses in a more differentiated way. This will lead to a more nuanced reflection about the world we live in, as well as a more supportive environment for

people affected by infectious diseases. Hopefully, a more nuanced perspective on viruses will additionally open up constructive conversations about how viruses are to be used in a metaphorical context.

Notes

1. Job has to suffer from several diseases although God declares: "There is no one like him on the earth, a blameless and upright man who fears God and turns away from evil" (Job 1:8; NRSV). In the case of a man born blind Jesus also declares: "Neither this man nor his parents sinned" (John 9:3; NRSV). These accounts are commonly understood as a test of faith, or as a starting point to reveal God's mercy and power.
2. In Polkinghorne's "free-process defense" the self-emptying of God, called kenosis and based on Philippians 2:6–8, enabled his creation to have genuine freedom to develop.
3. See Neil Messer's criticism and Christopher Southgate's response on this topic (Messer 2009; Southgate 2011).
4. He argues that the difference in freedom between himself and an ex nihilo created doppelganger merely results from experience and the time to acquire certain moral and cognitive properties. An ex nihilo created doppelganger who develops in a womb and interacts with the world as long as he has, he argues, would be just as free as he is (Wahlberg 2015).
5. The passages he refers to include Genesis 3, Isaiah 11, Romans 5 and 8 as well as Colossians 1:20.
6. Historically, three major scenarios of virus evolution were discussed. (1) In the "virus early" hypothesis, also called the "primordial virus world," viruses directly descended from the replicative elements that existed during the precellular stage of evolution. (2) In the "regression" scenario, also known as "reductive virus origin" viruses are the result of degenerated cells that become obligatory intracellular parasites and lost their autonomy. (3) According to the "escaped genes" scenario viruses evolved from host genes that acquired the ability of selfish replication on multiple independent occasions. Viruses in the currently proposed model by Krupovic, Dolja, and Koonin (2019) would be of chimeric origin.
7. One famous example is the transferrin receptor, a cell-surface receptor that regulates iron uptake, a process that is fundamental to life, but also facilitates cell entry of several mammalian viruses (Demogines et al. 2013).
8. The approach of this article is specifically virocentric. However, there are clearly broader biocentric issues needing wider discussion, which cannot be addressed within the scope of this paper. Furthermore, the term *virocentric*, as used in this paper, does not imply that value is virus-centered, but rather that existence and biological impact of viruses question our human-centered approach to interpretation. The term *virocentric* in this sense is borrowed from a paper that discusses a virocentric perspective on the evolution of life (Koonin and Dolja 2013).

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