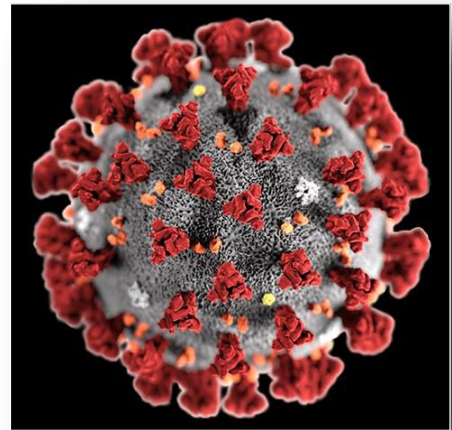


Are We in a Race with the COVID-19 Virus?

Ever since the COVID-19 vaccines began being approved for use in the UK, US and EU I've been listening to news reporters on television and radio describe the global situation as a "race" between virus and the vaccine. This seems to me a rather fundamental misunderstanding of the science that, unfortunately, exposes news organizations' fondness for using popular, widely understood and simplistic metaphors to make not-very-complicated situations (esp. in the area of scientific developments) "understandable" to the general public, irrespective of whether these metaphors are accurate or whether they actually do lead to greater understanding. Is the world now in a "race" with the virus? Yes. But it's not the sort of race you might think and its outcome will be very different from the outcome of a standard race.



In popular parlance a race is a competition in which two or more competitors attempt to outdo one another in some aspect of performance related to speed. It might be a foot race, a horse race, a dog race, a car race, a boat race, an air race (race between airplanes) or even a race to the moon and back. The common features of all races are that competition begins at a specified point in time (the start), ends when the competitors achieve a pre-determined goal (cross the finish line, return to Earth from the moon), and the winner is decided on the basis of who achieved the goal in the shortest time interval. This metaphor does not provide an accurate, or an adequate, description of efforts to control transmission of the COVID-19 virus. The race metaphor also implies that, at some point in the future, we will "beat" the virus and be declared the winner of the race, after which the race will be over and life will return to its normal routine. This implication is also neither accurate nor adequate. Indeed, it is highly misleading.

Viruses are not competitors with humans for world domination. They are not enemies to be vanquished in a fair, open and rule-based contest. They are, simply, aspects of the earth's environment.

Viruses appeared on Earth hundreds of millions of years before humans (<https://www.pnas.org/content/early/2011/09/02/1105580108>) and I daresay will outlast our species by an equally long, if not longer, interval. Controversy exists regarding whether viruses are living constituents of our planet in that they lack the cellular machinery required to reproduce themselves (<https://www.scientificamerican.com/article/are-viruses-alive-2004/>). Accordingly, they must inject their genetic material into other cells. This co-opts the infected cells' machinery to make copies of the virus. If this lack of internal reproductive capacity is ancestral – if it has always been part of virus biology – it could be argued that viruses occupy a gray zone between living and non-living entities. However, if this loss was secondary, the result of an evolutionary development from some fully reproductive ancestor, viruses would be considered highly evolved cellular parasites and definitely part of the living world. It's doubtful this issue will ever be resolved insofar as the ancestor(s) of viruses have yet to be discovered and evidence of microbial reproduction would not be expected to fossilize readily. Irrespective of this nomenclatural uncertainty, viruses certainly do exist and they certainly effect the living world.

Humanity is not in a race with viruses any more than it is in a race with bees, newts, or palm trees. We are all part of the web of life and humanity needs to do a much better job of getting along with its furry, feathered, scaly and slimy neighbors. With regard to the COVID-19 virus, the physiological by-products of its cellular invasion are truly horrendous and heroic efforts must be made to ameliorate them to the greatest extent possible. Unfortunately, these effects have been made much worse, and more widespread, than they could, or should, have been in countries that did not prepare adequately to deal with what was universally acknowledged to be a major global health risk, not to mention one that was known to have occurred in the past repeatedly. All qualified experts were also in unanimous agreement that a pandemic would certainly occur again at some point in the future and had made this prediction plain to medical policy makers, again, repeatedly. Hopefully we now have all learned our lesson that we must take the risks imposed by the appearance of new, virus-based, respiratory infections seriously and prepare for their inevitable occurrence.

Another implied aspect of the race scenario is that, once the competition has begun the competitors are not allowed to argument their performance capabilities in any way. If I was running a foot race with a colleague I would not regard the race as fair if, in the middle of the competition, my colleague was allowed to ... jump in a car and speed toward to finish line ahead of me; or turn into a bird and fly away. That's not what races are about. Yet that is exactly the situation we find ourselves in with the COVID-19 virus.

Owing to its high mutation rate COVID-19 can, and has, turned into different forms, termed variants (COVID19 [Kent], COVID19 [S. Africa], COVID19 [Brazil]). These variants, which now number in the 100s,

have different physical and biochemical characteristics that may effect their transmissibility, virulence, tolerance to environmental changes, and susceptibility to vaccine control. Variants arise through the normal processes of genetic mutation and there is absolutely nothing humanity can do to prevent that from happening. All we can do is respond by developing vaccines designed to control the new variants transmissibilities and/or mitigate their effects on our bodies. But because mutations happen randomly we cannot predict what new capabilities the COVID-19 virus might acquire through mutation; or when, or where these might occur. Thus, we are now destined always to be on the back foot when it comes to addressing the medical fallout from COVID-19; always responding to, never out in front of, the virus.

When some reporters refer to our race with COVID-19 they might mean a race to prevent as many lives being lost as possible. But again, this falls far short of a precise analogy insofar as, regardless of what we do or how well vaccination programs are organized, we will never know how many lives were saved. More importantly, it is by no means clear we will ever be able to stop lives being lost to COVID-19. So, where is the winner in this scenario? Moreover, if lives continue to be lost, how can the race end? A race that has no finish line is not a typical race.

While our situation with regard to the COVID-19 virus cannot be described accurately as a normal race, there is one sort of race that does provide an accurate analog, not only with regard to what humanity's situation actually is, but what it must prepare for: an arms race. This term was coined in 1984 to describe the situation where nation states compete in the development of their respective militaries in order to intimidate one another politically, and so gain concessions, by threatening to overwhelm each other in a military conflict. Thus, from 1870 to 1914 the UK and Germany entered into a naval arms race in the run up to WWI. Similarly, from 1947 to 1991 the US and Soviet Union were engaged in a nuclear arms race, of which the race to the moon was a part. This arms race contributed ultimately to the economic collapse of the Soviet Union, but the arms race itself was unchanged even by this drastic development. It continues to this day under the sponsorship of the US and the Russian Federation.

In 1987, in his book *Evolution and Escalation*, the evolutionary biologist Geerat Vermeij co-opted the concept of an arms race to explain trends in the morphological histories of predator and prey species (see also Vermeij, 1982). Vermeij argued that parallel trends among ecologically-linked species, such as larger claw sizes of shell-crushing crab species and larger, thicker, and/or more highly ornamented (= strengthened) shells in their gastropod prey, could be seen as the result of positive feedbacks in an evolutionary race for survival – the biological equivalent of a military arms race – which, once begun, channels morphological variation along ever more elaborate and specialized lines. This view of evolution remains somewhat controversial, but it has enjoyed a good deal of popularity and is now regarded as a mainstream concept in evolutionary biology. To me, an evolutionary arms race is the best biological metaphor for our current, and likely future relation with the COVID-19 virus.

If, as is desirable, the current crop of COVID-19 vaccines is effective in preventing the virus' transmission, selection will be high for mutations that allow new virus variants to circumvent the limitations imposed on old variants by vaccination. Meeting the challenge posed by new, vaccine-resistant variants will require the

development of new vaccines. This, in turn will (likely) induce the appearance of new variants that are resistant to the new vaccines. And so on. And so on.



Examples of species involved in evolutionary arms races. Top row: the common periwinkle (*Littorina littorea*) and the European Green Crab (*Carcinus maenas*). Bottom row: moths (Heterocera) and bats (Chiroptera).

With the appearance of the new COVID-19 variants in Kent, South Africa and Brazil humanity has likely entered the first stages of an evolutionary arms race with the COVID-19 virus. But arms races aren't really races, they're positive feedback loops and loops, as we all know, don't have an end. There is no finish line and no winner. The race goes on until one competitor simply leaves the field (e.g., Germany's renunciation of militarism in the wake of its defeat in WWII) or arises again in another guise to continue the race (e.g., The Russian Federation). With regard to evolutionary arms races, some believe this process has driven morphological changes in competing species for literally tens of millions of years (<https://jeb.biologists.org/content/219/11/1589>).

To prevent my having to end this essay on an (apparently) despondent note, let me hasten to

add that the idea of humans engaging in an arms race with disease-producing microbes is nothing new. This is what happens every year with the influenza virus, which belongs to the same virus family as COVID-19. Each year new vaccines are developed to control new variants of the influenza virus that have appeared over the previous year. Each year, lamentably, deaths occur as a result of influenza infections. These go largely unnoticed by society at large because we have accepted influenza as a normal part of our environment and adjusted our medical infrastructure to counter its effects as best we can. This normalization of, and adjustment to, COVID-19 will also happen in time. The existence of effective COVID-19 vaccines will help us more toward its normalization, and the sooner societies move to this view of COVID-19 better it will be for all of us. But the outcome of our arms race with COVID-19 will not be victory, it will be acceptance.

We will learn to live with this virus. We've done it before with other viruses. We really have no choice in the matter. What we do have is a choice about though, is how we will live our lives alongside this new viral aspect of our environment. What will we change? What will we retain? Who will these changes fall on most heavily and what will the rest of us do to help them bear that burden? So far as I can tell that debate has yet to begin in earnest though many seem to be hard at work on their position/demand statements. Let us hope a genuine debate follows and let us also hope it is conducted more widely, more thoughtfully, more constructively and with a more accurate understanding of the issues involved than many of the previous public debates we've had recently.

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