

Viewpoint: mRNA and synthetic biology offer rays of hope after Annus Horribilis

The [season](#) of [retrospectives](#) is [upon](#) us. The past year will be long remembered with dismay and sadness, as the four horsemen—[war](#), [famine](#), [pestilence](#) and [plague](#)—each had robust runs. But the laurel, woven this time of poison ivy, clearly goes to plague, as humanity was [smitten](#) with the worst one in more than a century.

There is no excuse. [We saw it coming](#). We were [amply warned](#). We had [plans](#). But through the [intellectual](#) and [moral bankruptcy](#) of [some](#) of our [politicians](#) we failed to execute. And the plague came.

The [Great Influenza](#) of 1918 raged around the world for 24 months, killing as many as 100 million. The present plague has brought tsunamis of death and suffering that have washed across the planet in ongoing waves, reaping by [official count](#) at least 5 million, though probably well over twice that, with another 269 million smitten short of death. And the numbers continue to rise.

In such an [annus horribilis](#) one could be forgiven for failing to find much to celebrate. But as terrible as the year has been on so many levels, we have also seen rays of light and hope, most clearly in the advent of a [powerful shield](#) against the plague. A new technology—mRNA—delivered some of the [most effective protection ever seen](#) from a vaccine, on a timeline that [shattered](#) previous records to dust. This is no small thing. It [promises](#) to change [everything](#).

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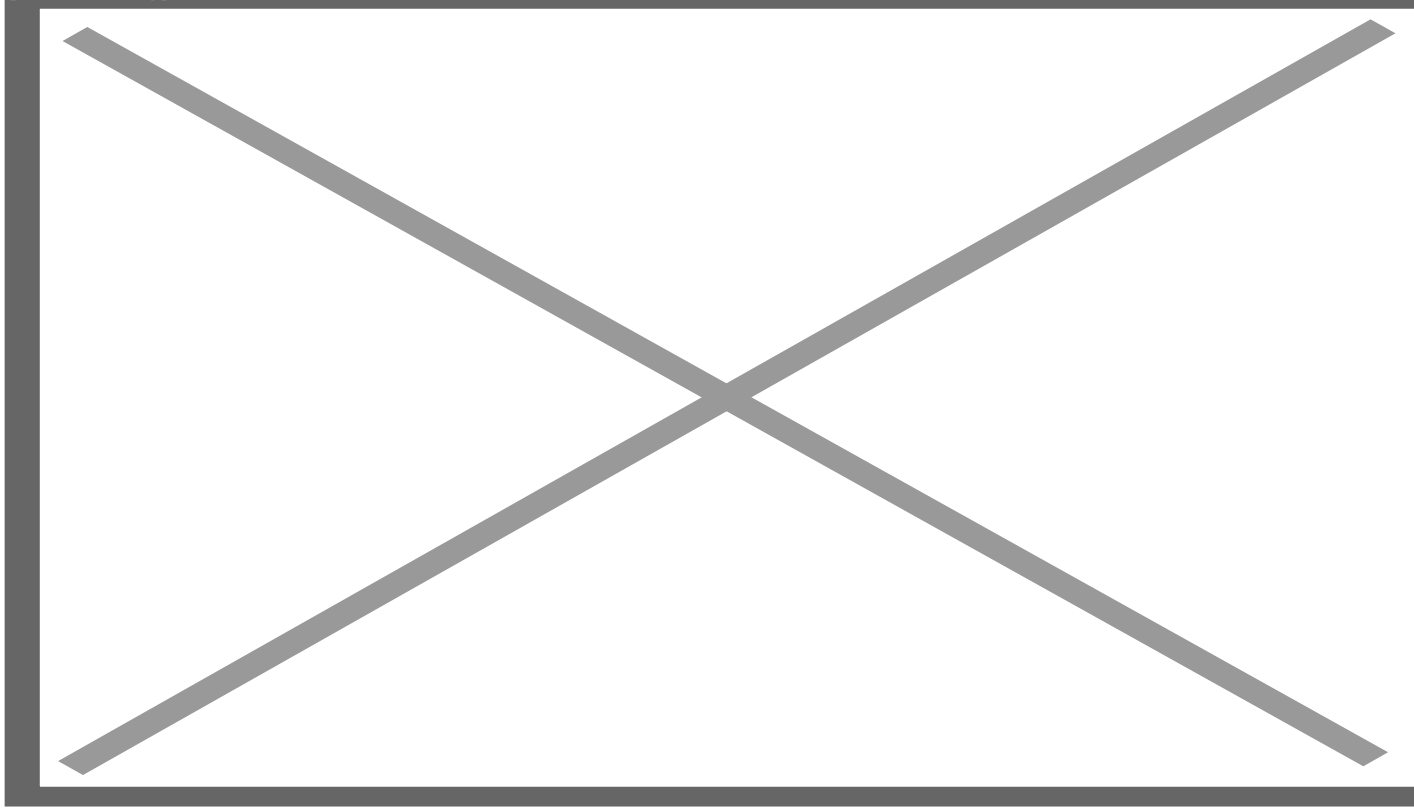
There are flies in the ointment, of course, but the same technology that has delivered such a formidable shield against SARS-CoV-2 is even now [being enlisted](#) to save us [anew](#) against the ravages of [variants](#) spawned by our political failures. At the same time these innovations are also ushering in a [new era](#) of [cancer therapeutics](#) and vaccines for diseases that have resisted older technologies like [HIV](#), [malaria](#), [Zika](#), and the specter at the annual banquet, [influenza](#). But the revolution mRNA technology has brought to vaccine design and manufacture is a modest foreshadow of the medical [revolution exploding](#) from gene editing, which showed [expanded promise](#) in 2021. Plans have been developed to use CRISPR-mediated therapies to address [Alzheimer’s disease](#), and clinical trials were launched to address previously intractable [metabolic disorders](#) including many we are [still struggling](#) to understand. Other researchers are using CRISPR to [regenerate lost limbs](#). Meanwhile, these technologies are vaulting Hippocrates’ [admonition](#) that “food is medicine” past the [crackpottery](#) it has [seeded](#) for generations and actually delivering foods with enhanced and novel [therapeutic benefits](#).

At the same time that biotechnology advances are reshaping tools for public health and medicine, we see no less momentous innovations in other fields. Almost no sector is untouched, but the greatest flowering to date has arguably been in agriculture.

The [benefits](#) to date of crops and [livestock enhanced](#) through biotechnology have been considerable, improving the economics, productivity, and [sustainability](#) of agriculture. As [widely foreseen](#), gene [editing](#) is [rapidly](#)

[building](#) on this [foundation](#). And in lockstep with such improvements come benefits for the biggest challenge facing humanity right now, climate change.

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Credit: Norrie Russell

There are [myriad opportunities](#) for gene editing and genetic engineering to [ameliorate aspects](#) of climate change. We're figuring out how to reduce or eliminate [methane from cattle](#), capture more carbon in crops, [trees](#), even [maritime seaweed farms](#). And agricultural enterprises are devising new ways to make it all [economically viable](#).

As if all that weren't enough to convince even the most skeptical that innovative biological technologies are essential, [synthetic biology](#) (which the National Institutes of Health defines as "redesigning organisms for useful purposes by engineering them to have new abilities") is [pushing](#) innovation into entirely [new territories](#), [from clothing](#) and [furniture](#) manufacturing to [cruelty-free meat](#) and [leather](#) to [pollution reduction](#) and the manufacture of [jet fuel](#). These technologies provide [new tools](#) to address the challenges we face in a manner limited only by [our imaginations](#).



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But developing and deploying these innovations remains scientifically challenging. And while the talent and funding required are being applied, the efforts and investments face a daunting burden that is usually overlooked: government regulations. At the same time governments around the world are investing heavily in biotechnology R&D, almost without exception they impose regulatory hurdles that [discriminate heavily](#) *against* innovation and enforce extended reliance on obsolete and damaging products and practices.

ITIF has [written extensively](#) on these issues and offered [numerous solutions](#) but, in a nutshell, virtually none of these regulations, all ostensibly promulgated in the pursuit of safety, actually applies levels of scrutiny proportional to the hazards involved. After three decades of plantings on hundreds of millions of acres around the world with an [enviable](#) safety record, crops improved through the most precise and modern techniques are still subjected to much more searching and onerous scrutiny than new varieties developed through chaotic, random, and brutal [irradiation mutagenesis](#), which has for decades been widely and rightly accepted as safe. This makes absolutely no sense.

The illogic is so overwhelming that even long-time opponents are [re-evaluating](#) their positions, and some are even [cautiously](#) embracing specific [applications](#). In view of the positive results and favorable [environmental](#) and [socioeconomic](#) impacts, it is reasonable to [expect](#) this trend [will continue](#) to [reshape and improve](#) the [landscape](#) of [acceptance](#), but this is not happening fast enough. The [future](#) is speeding

toward us.

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