

AI and bio-weapons

by GWYNNE DYER

'Artificial intelligence' based on Large Language Models is shaping up to be the most efficient destroyer of value since the South Sea Bubble. After the crash, some specific functions of AI will eventually turn out to be genuinely revenue-generating, and a lot of jobs will duly disappear. But the biggest winner (and potentially biggest loser) is medical science.

Dr Brian Hie, a chemical engineer at Stanford University in California, has just revealed that his team has made the first viruses designed by artificial intelligence. They are 'bacteriophages,' viruses that only infect bacteria and are widely used to treat people with infections that resist other treatments.

However, natural bacteriophages sometimes fail, so Dr Hie used generative AI to design new ones that might do the job. The AI generated thousands of designs for new genomes that more or less fit the bill, and he chose around 300 of them to build in the lab. It's hard work, not magic, but he ended up with sixteen 'novel' bacteriophages that might work.

He applied them to petri dishes containing two harmful strains of *E. coli*, a common bacteria that lives in the human gut, and they killed the bacteria off. It's still early days, but if it is truly becoming possible to tailor-make bacteriophages that target specific bacteria, then we may be getting a major new weapon in the struggle against antibiotic resistance.

That problem is growing rapidly as the overuse of antibiotic medicines gives bacteria endless opportunities to evolve into new, more antibiotic-resistant forms. The Institute for Health Metrics and Evaluation estimates that 1.34 million Americans will be dying each year from antibiotic-resistant diseases by 2050 (up from half a million now).

The ability to design genomes for unique bacteriophages that target specific diseases is indisputably a Good Thing for health care, but it is not necessarily a great thing for the world at large. 'Although this is promising for life sciences application,' wrote Prof. Tom Inglesby of Johns Hopkins University, 'it also raises urgent biosafety and biosecurity questions.'

'The ability to compose viral genomes now exists; the governance to safely steer it does not.' Such genomes might encode new pathogens that cannot be contained by existing countermeasures. 'Probably nothing as bad as the Black Plague or even Covid, but who knows?'

There are no mad scientists in this story. Not only did the scientists working on this project follow all the existing protocols; they bent over backwards to ensure that what they were doing was safe. The training of their AI deliberately did not include the code for any viruses that can infect human beings.

They have not created 'Life' - viruses are not alive - although one day they might be able to synthesize a bacteria (which is alive) if they continue on the road they are following. However, they have already created a new field of biology that goes beyond the natural world. You could call it 'synthetic biology' - and the sky's the limit.

The downside of this triumph is the fact that everybody working in the field, and perhaps already some people with less admirable ambitions, knows that it is now possible, at least in principle, to design new viruses that will do almost anything the designer wants. The cat is out of the bag, and there is no way to stuff it back in.

Science at the sharp end is often like this, with great potential for good and considerable potential for evil. It's people who decide how new scientific breakthroughs will be used, and that's what human beings are like. They are also slow to respond to new risks until some major disaster persuades them that they should take the danger seriously.

The biomedical and allied trades are currently having a golden age of discovery, and the 'ability to compose viral genomes' is only

one of several scientific domains in which great advances are accompanied by high risk. The security in the labs is usually very good; the wider dissemination of sensitive information is not well controlled.

Synthetic biology will doubtless save a great many lives, but it will also make possible a whole new suite of 'low probability, high impact' events. A really bad global pandemic, created with malice aforethought, could be just as destructive as a medium-sized nuclear war. Moreover, it would take a lot fewer people to get a pandemic going.

Scientists are diligently applying the usual biosafety rules to this new biotechnology, but it's still not enough. Stricter rules and closer supervision are needed, even if necessary at the cost of slower progress in the new technology.

Treat it like they treated the new nuclear technology in the 1940s, because the consequences of misusing it could be just as serious.