

Commentary

Khaaan of Worms!

Blair Granville (Insight Analyst, Portland Press)

Ask someone to describe what *Star Trek* is about and you may conjure up gleaming spaceships, pointy-eared aliens and hyper-futuristic technology such as the transporter or warp-drive. But you are less likely to elicit the words ‘molecular biology’. Beyond the existence of various knobby-headed aliens, there is a distinctly ‘physics-y’ feel to *Star Trek*. Energy fields, exotic matter and phase inverters are routine in the 23rd and 24th centuries, but this is not so for biotech. Even the medicine of *Star Trek* has an inorganic feel. Handheld scanners diagnose any illness or injury, and the ‘hypospray’ means even injections no longer involve puncturing the skin. Despite all that the writers of *Star Trek* have imagined, they have always shied away from anything that might violate the boundary between our bodies and the outside universe. Instead, when such ideas do appear, they are presented as a foil to *Star Trek*’s utopian ideals, and the ethical hinge upon which the plot swings.

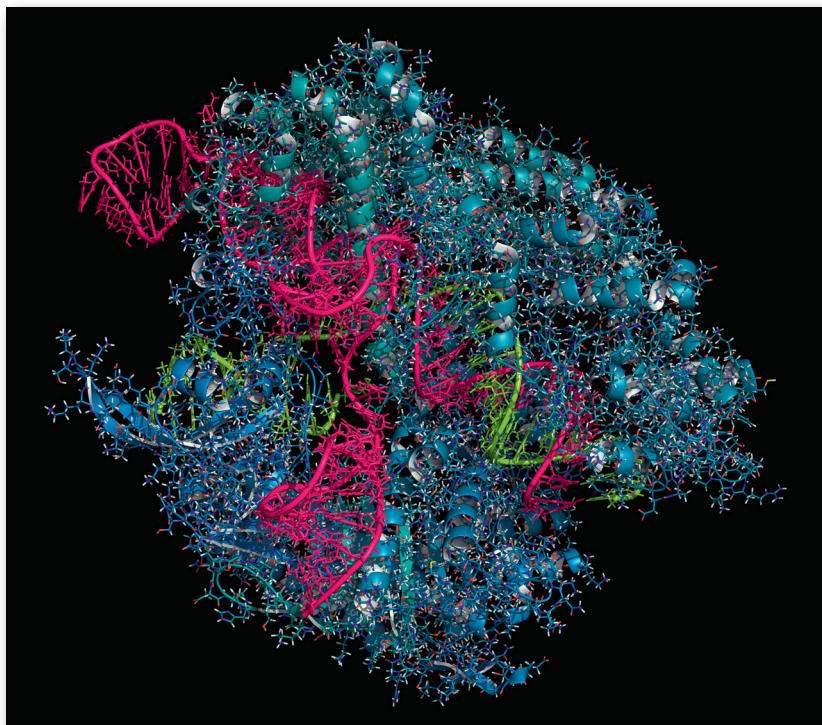
There is of course the infamous Borg, a hive-mind collective that coldly assimilates any new biological and technological distinctiveness. It is effectively a cautionary tale about transhumanism, one that captures the dual fears of both biological and mechanical corruption of human individuality. But perhaps the most famous single villain of *Star Trek* is the genetically engineered super-human Khan Noonien Singh, from the 1982 *Trek* film *The Wrath of Khan*. His name – KHAAAAAN! – was screamed by William Shatner in a now iconic paroxysm of over-acting, and more recently Khan was re-booted by a megalomaniacal Benedict Cumberbatch for 2012’s *Star Trek: Into Darkness*. In both, Khan is actually a throwback from closer to today. His kind is wholly illegal in Captain Kirk’s time, and he was awoken by mistake from cryogenic sleep. In fact, Khan is a creation from the era of the ‘Eugenics Wars’,



Khan (Ricardo Montalban) and Joachim (Judson Earney Scott) *Star Trek II: Wrath of Khan* © Paramount Pictures

which, according to the original show, occurred in the 1990s. Although the prediction of a dystopian 1990s was arguably a little off, Khan's time of origin seems to be a message: only in a barbaric past would humans dare to mess with the natural order of biology. In the noble future depicted in *Star Trek*, the nature of physical reality is probed and prodded, but the essence of a human body is as sacrosanct as ever.

It just so happens that this barbaric past is our present, and perhaps not only in the fictional sense. Since the year 2000, technology that offers up the promise of altering human DNA has developed with remarkable speed; first in the case of zinc-finger nucleases, then TALENs (transcription activator-like effector nucleases) and most recently CRISPRs (clustered regularly interspaced short palindromic repeats). In *Star Trek*, there are clear rules about when technology like this can and cannot be used. It is only legal to use it to cure genetic diseases, using safe and proven methods. But, in the real world, the rules have not really been made, and the cures are still a tantalizing possibility that now seems almost within our grasp. In just a little over 10 years, CRISPRs went from an interesting new facet of bacterial biology to a headline-making piece of genetic technology. The technology overcame yet another technical hurdle in April this year, when a team from Sun Yat-Sen University in Guangzhou, China, announced that they had used it to edit human embryos. Just 2 months before that, in February, the UK House of Commons voted to allow mitochondrial DNA replacement therapy in humans. This decision is significant not only for the diseases that it will help to cure, but also because it is a form of genetic engineering that is passed on to the next generation. Even more recently, in early November, doctors from Great Ormond Street Hospital in London announced a pioneering treatment of a 1-year-old girl with leukaemia, using TALENs to modify donor T-cells which were then delivered intravenously to the patient. So far, the cancer appears to have been eradicated. Despite the remaining technical barriers, it is increasingly hard to believe that human genetic modification is an issue for the future, rather than the present.



CRISPR-CAS9 gene editing complex from *Streptococcus pyogenes*. The Cas9 nuclease protein uses a guide RNA sequence to cut DNA at a complementary site. Cas9 teal/blue; RNA magenta; RNA lime green.

Star Trek portrays a world stripped of technological barriers and left only with ethical ones. Yet, for a show with a reputation of exploring grey areas with more subtlety than just 'man versus monster', it does a remarkably good job of painting synthetic biology in stark black and white terms. On one side stands Captain Kirk and his crew, the epitome of human health, and on the other is a terrifying evildoer such as Khan, and there is a clear line between. This clarity seems to be a common trope among science fiction that deals with genetics. However, for us humans of the 21st Century, the line has not yet been drawn, the trial and error process has yet to be commenced, and there is no cultural consensus on the predicament. We may need one soon though – as *Star Trek* teaches, the promises of technology mean that, before long someone, somewhere, will boldly go where no one has gone before. ■