Unnatural selection

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CRISPR on Netflix

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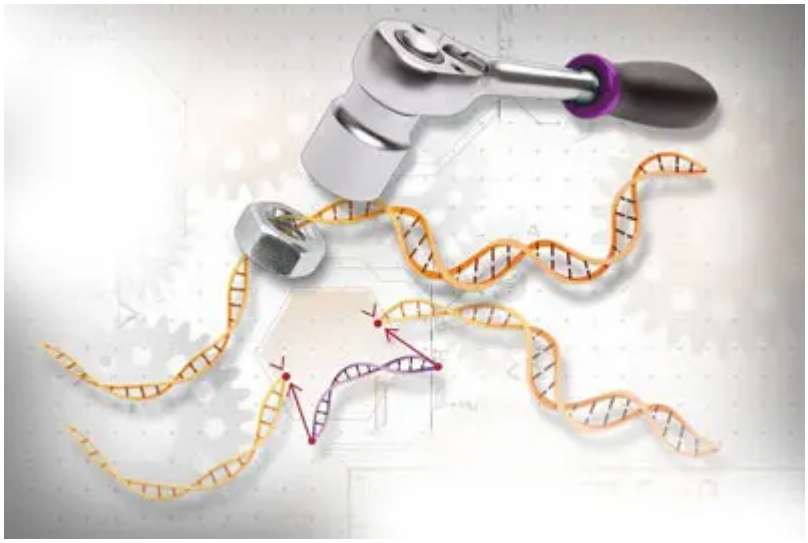

by Robert Carter and Scott Gillis

The possibility of altering human genetics to create designer babies or to improve the human species has been in the realm of science fiction for decades. Well, the ‘future is here’.

In October of 2019, Netflix released the first season of a new miniseries called *Unnatural Selection*. It focuses on recent advances in genome editing and the many moral and ethical dilemmas associated with it. As Christians, we need to be aware of this new and growing field, for it is no longer ‘science fiction’. Instead, human cloning, designer babies, and the potential for the genetic enhancement of humans is staring us in the face. We cannot simply claim a few scientists are ‘playing God’, because the ability to do such things is more widespread than most are aware and because the field is advancing quickly. We need to develop an informed view that is based on what is possible and *what is actually being done today*.

Sadly, we cannot recommend this series to our supporters due to the subject matter and the rough language (including several speakers repeatedly breaking the 3rd Commandment). However, a mature person who wants to gain a better understanding of what is going on in this arena might want to expose themselves to the material. Please use discretion. This series is definitely not for children.

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Throughout the series, many of the players anthropomorphize evolution, claiming evolution 'did' this or that. But evolution is not a conscious entity. Even if it were real, it could not *do* anything. One person in the documentary even calls himself an 'evolutionary engineer', somehow missing the fact that he mixed a theoretical and random process that has no purpose or design with a decidedly human process of intelligent design and creative thinking. But there is one thing each viewer must remember: the feats of genetic engineering displayed in this series are clearly operational science. The procedures displayed do not directly rely on an evolutionary history or belief, no matter how often they refer to evolution. A quote from Charles Darwin might start each episode, but one of the authors of this article (RC) is part-owner of one of the tools being used by some genetic engineers today.[1] In order to have a better idea of the true nature of science in this context, we strongly recommend, before watching this series, everyone first read the article *It's Not Science*.

The first season includes four episodes that track several different people: three patients, a biohacker set up to look like a college professor, a laboratory scientist, a dog breeder, a businessman, and two couples. Two of the patients were born with genetic defects. One is slowly going blind. The other is slowly becoming paralyzed. The third patient carries HIV (the virus that causes AIDS). All three are treated with DNA-altering technologies over the course of the show. The 'professor' is known for openly advocating biohacking and for experimenting on himself, in public. The dog breeder is an untrained layman who is trying to learn new things. The businessman is trying to sell an antibody to the AIDS patient, using the dog breeder as a manufacturing intermediary. The scientist is trying to convince different communities to release genetically modified species into the local environment. One of the couples is having problems with infertility, so they turn to "three-parent embryo" technology. The other couple wants a blue-eyed boy, so they go to a reproductive clinic.

Although much of the production style gives a notion of 'reality TV', as far as we can tell, these are real people and the show is dealing with real situations. This does not mean none of the scenarios were set up on purpose or that the producers did not engineer certain scenes for dramatic effect. But what was being discussed, shocking as it may seem, is certainly in the realm of today's technology.

CRISPR

At the center of all this activity is a new technology called *CRISPR-Cas9*. This enzyme system serves as sort of an immune system for some bacterial species. They can take foreign DNA and stick a copy of it into their genome. This requires the ability to find a specific location in the genome, cut the DNA, insert the new DNA, and repair the cut. In the end, they accumulate short sections of viral DNA that together are referred to as 'clustered regularly interspaced short palindromic repeats' (CRISPR). These were first discovered in the 1980s. Associated with CRISPRs are a set of genes called CRISPR

associated systems (Cas). The proteins produced by these genes have helicase and nuclease motifs, meaning they appeared to have something to do with the DNA structure. They were first reported in 2003.

But in 2012 the world changed.

This was the year several researchers figured out how to use Cas9 as a way to manipulate any DNA they choose. Cas9 uses a guide RNA to 'find' a target location in the bacterial genome. The guide section literally sticks to complementary DNA. By changing this RNA, they were able to change the target. Then by changing the other end of the RNA, they were able to change what sequence would be inserted. This has given us an unbelievably powerful and accurate tool for genetic manipulation.

In 2015, the first reports of changing human DNA in cultured human cells were published. Then, to worldwide shock and almost universal condemnation, the birth of several CRISPR-edited babies was reported in China in 2018. The Chinese government rightly shut down the laboratory and the work they were performing. But two girls had already been born (and a third child was already on the way).

Thus, no longer is this a pipedream or the subject of sci-fi. The genetic manipulation of human DNA is a real thing, and the implications are huge. In a few short years, your doctor might sit you down to talk about a new treatment for some ailment you are experiencing. This treatment might just involve the use of *CRISPR-Cas9*, or something similar. But there is a moral hazard here. Will you remember to ask the doctor how many embryos were destroyed or how many babies were selectively aborted in order to develop this new procedure?

The dog breeder

Dog fanciers are a picky lot. They will pay top-dollar for a unique-looking animal, and they like their pets to not suffer from debilitating problems. Yet, centuries of selective breeding have created many genetic issues in multiple breeds. Thus, the lure of genetic engineering in dogs is strong. Not only can we possibly shorten the amount of time it takes to generate a new breed, but we might be able to fix the problems within existing breeds.

Enter one main character in the series. He is tinkering with dog DNA, with the help of the biohacker. Yet, his words clearly indicate he knows little about what he is doing. He might be a good technician, but he completely misunderstands the technology he is using. In order to perfect his techniques, instead of starting with the gene he wants to insert, he is using a green fluorescent protein (GFP) gene. Full disclosure: this was the subject of my (RC) doctoral dissertation.[2] In fact, he might even be using the gene my team patented. He works on his technique until a significant number of cells are 'glowing' green under the microscope. In this way, he can be confident that a similar number of cells will receive his DNA of choice when he switches away from GFP. Note: they did not specify what he was trying to add to the dog genome.

But when discussing his green cells, he says, “This is bioluminescence. They produce their own light chemically.” But this is completely false. These cells are not producing their own light (bioluminescence). Instead they are fluorescing. They are taking the UV light and shifting the color to the visible spectrum. We use fluorescent products all the time. You may even be wearing something made with a fluorescent dye. Nobody would say their clothes “glow” in the dark. In fact, “GFP” is clearly marked on the bottom of his petri dish and a black light is clearly visible in the shot. We are not trying to nitpick here. This is basic science. Yet, the dog breeder is able to do his work without truly understanding the basic scientific principles behind what he is working on.

Honestly, this is terrifying. The ‘democratization’ of the human genome was celebrated when it was publicly released in 2001. Today, the genomes of many species can be considered as ‘open source’ code. In some ways, there is a very low cost of entry into genetic engineering. The information is readily available, and the laboratory costs are not astronomical. Anyone with a decent grasp of technique can do all sorts of genetic manipulations with little capital outlay, literally in their garage.

Now consider how much it would cost to clone a human. Or think about what changes could be made to the DNA of living humans by people who only *somewhat* understand what they are doing. The genetic genie is out of the bottle. Just about anyone, with but a little money and training, can do things with DNA that were unimaginable to Nobel laureates just a few years ago.

The biohacker

Josiah Zayner is known for his advocacy of biohacking and for injecting himself, in public, with CRISPR-Cas9. He claims this was carrying a gene that would enhance muscle growth. But he also says that only a few cells would be transformed and that multiple injections would be required to have any noticeable effect. Many believe his advocacy is reckless. Appealing to “personal choice” and “informed decisions” sound good on the surface, but we are talking about people’s health and minds. Sure, he can do whatever he wants with his body. But who will pay the healthcare costs for him, or others who follow his example, if he messes up? This is not a simple issue.

The blind boy

(Spoiler alert) One of the success stories in this series is that of a boy who is slowly going blind. He was born with a defective gene and the prognosis is total loss of vision. His parents take him to a hospital where they cut open each eye, lift the retina, and add a few drops of a liquid containing a CRISPR-Cas9 system that has been modified to locate the mutation and replace it with a correct version, thus restoring gene function. When we are first introduced to the boy, he is having trouble finding the toys on the floor right next to him. When we last see him, he is racing around a go-cart track and his mother is crying in both fear and delight.

This raises a question: All they did was modify the genes in the cells at the back of his eyes. In the future, it might be possible to do a full-body gene modification so that this boy's children would not carry the gene. This is referred to as 'germ cell modification' and it is almost universally frowned upon by the scientific establishment. The reason for this is that the technology is new, and we cannot be certain that a future human might not be harmed in an as-yet unknown way by changing a gene. Yet, the ability to do exactly that is out in public.

Watch Video At: https://youtu.be/IpstnHJXdio

The paralyzed man

Sadly, the young man who was slowly being paralyzed was not helped by an injection of a modified CRISPR-Cas9 into his spinal cord. In fact, after an incident of brain swelling, he is worse off at the end.

The AIDS patient

This is a sad story. He appears to be manipulated by the businessman (who, we learn at the end, died in a hotel room of an apparent suicide). After injecting himself with low doses of an antibody that is reported to stop HIV in its tracks, he obtains a negative result on his next blood test. After consultation, he is pushed into upping his dose while at the same time appearing to get cold feet. The dog breeder and the biohacker are telling him to be careful. In the end, he still carries HIV.

The scientist

Once people realized that you could add CRISPR-Cas9 to the genome of any organism, the concept of a ‘gene drive’ was born. Once in place, the normal process of genetic recombination, where a child has a 50% chance of inheriting a gene carried by a parent, is broken. Instead, once in place the system will copy itself to the other chromosome. When children are conceived, they will inherit one copy from the infected parent, and that will quickly copy itself over to the other chromosome. In the end, the insert will relentlessly spread to all descendants of the original person or animal and could quickly replace all other versions of that gene.

The scientist is shown discussing this with the residents of Martha’s Vineyard (an island off the US East Coast where former president Obama maintains a home). This island is a hotspot for Lyme disease, and the main carrier of the Lyme-carrying ticks is the white footed deer mouse. What if, the scientist argued, they engineered a mouse so that when a tick bit it the tick would die? What if this were put into a gene drive so that it could spread to all mice on the island?

The scary part about gene drives is that there is no way to stop them. The documentary also visited New Zealand, where they are having a tremendous problem with introduced rats. If the rats could be engineered with a gene drive that caused all rats to be male, the species would be wiped out in only a few generations. This is not a fairy tale. We could do this. But what would happen if a male rat with this modification stowed away on a ship and was brought to an Asian port? Rats across Asia, Europe, and Africa would be eradicated, all because the New Zealanders wanted to be rodent free.

The end credits stated that permission had been granted to release tick-killing gene drive mice on Nantucket Island. This is farther offshore than Martha’s Vineyard, but it would not be impossible for an engineered mouse to escape to the mainland. One might even be *intentionally* brought to shore. “Rats!”

Couple #1

At a medical facility in the Ukraine, couples with infertility problems can have a three-parent baby created. This is done by first removing the nucleus from an unfertilized egg that was obtained from a donor. They then create a fertilized egg from the egg and sperm of the couple, remove the nucleus and insert it into the donor egg. In the end, the child inherits DNA from three people: the parents contribute the nuclear genome and the donor contributes the mitochondrial genome. The documentary shows the process happening under a microscope.

Theoretically, this is inconsequential because it is entirely feasible that this mitochondrial strain could be associated with this new genome at random. It’s not like there is anything ‘new’ being created and all these genetic elements are floating around in the population already. It is also possible that the donor egg has the same mitochondrial DNA as the mother, in which case it would not even be possible to detect the extra ‘mother’.

However, from a biblical perspective the experimentation required to do this leads to the death of human beings (embryos). Also, what would happen if the baby failed to develop properly? We strongly suspect that such a child would be subjected to selective abortion. It grieves us to even think about it.

The US banned this procedure several years ago. What most people don't know is that about a dozen children came into the world through this procedure before it was banned. They are teenagers now. The UK famously legalized the procedure more recently, and we see in this documentary that people can go to the Ukraine to have it done today. This illustrates a tremendous problem: variability in international law. What might be illegal in one place is not in another. And some places in the world have trouble prosecuting the laws that *are* on the books.

Couple #2

In another medical facility, two good-looking people come in for a consultation. They want a baby. But they want a blue-eyed baby. The mother has dark hair and striking blue eyes and they want their child to have the same. They also want the child to be a boy.

So the doctor creates eight embryos, allows them to grow to a certain stage, then removes some cells for genetic testing. They find one blue-eyed boy embryo and make the announcement to the now-happy couple. We are told at the end that this resulted in the birth of a healthy baby. What we are not told is the fate of the other seven embryos. They could have been saved for the couple for later use. Or they could have been destroyed. Or they could have been used for experimentation, depending on national laws.

We also wonder how the parent-child relationship might be affected if the resulting child is less than perfect, either physically, mentally, or emotionally. The intentional genetic manipulation of embryos is not a zero-sum game. There are real implications of this, on many different levels.

The moral hazard

Embryologists generally feel little moral hazard in experimenting on embryos this young. The incipient human cannot feel or think and cannot protest whatever might be happening to it or around it.
Embryologists have decided that it is OK to experiment on embryos less than 14 days old. This is the limit of natural "twinning", where the embryo can split into two children with no ill effects. It is also the stage at which the neural crest starts to develop. This is the beginning of the nervous system and the ability to move and the ability to detect environmental stimuli rapidly develops from this point. Thus, embryologists generally feel little moral hazard in experimenting on embryos this young. The incipient human cannot feel or think and cannot protest whatever might be happening to it or around it.

From a biblical and scientific perspective, however, life clearly begins at conception. The Bible talks about unborn children as if they were alive. Scientifically, you don't have human life until you have fertilization of an egg. The egg and the sperm do not even carry a full human genome. When combined, however, nothing will stop the development of that little human short of trauma. Barring a developmental defect, failure to implant in the womb, or, God forbid, an abortion, that fertilized egg will develop into a member of society. The *only* place to draw the line between life and non-life is at conception. Yet, much of this new knowledge is being generated using human embryos within this 14-day window.

Conclusions

The ability to change human DNA is a serious issue that is not going to go away. We now have the technology to clone humans. We can now select embryos with whatever characteristics we desire. We can now modify defective genes. This is not science fiction any longer. And it is coming to a doctor's office near you. We need to be informed on these issues, and Christians need to develop an educated opinion on these topics sooner rather than later. Please stay informed, please pray, and please get engaged in these issues at a societal level.

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References and notes

1. Gibbs, P.D.L., Carter, R.W., and Schmale, M.C., Fluorescent Proteins from Aquatic Species. US Patent #7,291,711, 2007. Return to text.
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