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Mankind 2.0:
The Volatility of a Genetic Revolution

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Genetic engineering can reap countless rewards for the human race. However, these benefits may come with a steep price. Many people have taken up the call for genetic engineering to further the human race's potential. Others, however, are far more skeptical of mankind's ability to wield this power justly. As the capabilities to edit the human genome continue to grow, so too does the danger faced by the entire human race, and as such, it is necessary to create regulations now to avoid the dangers that loom over the horizon without neglecting the asset that gene manipulation offers to humans as a species. Though genetic engineering is not ready for use on humans, Congressional regulations must be put into place that outlaw the use of gene editing in a way that affects the human germline, as well as to prevent use of genetic engineering as a cosmetic tool that may create discrimination. These regulations must be enforced by ethical review boards to assess the medical or scientific relevance of cases of genetic engineering in order to prevent instances of abuse and stave off catastrophic consequences to the human germline and the overall human race.

Genetic engineering has reached a revolution. Methods of editing the genetic code within organisms have actually been utilized for decades, with the most notable tool being recombinant DNA. However, what has brought genetic engineering into the social and scientific spotlight as of late is the discovery of a ground-breaking new tool for gene editing: CRISPR/Cas9. CRISPR/Cas9, or Clustered Regularly Interspaced Short Palindromic Repeats, is an enzyme found in bacteria that has been modified for usage in genetic editing. Bacteria utilize this enzyme to cut part of the genetic code out of attacking viruses and integrate it with their own DNA, allowing them to target that specific virus using the new piece of genetic code and better defend themselves in the future (CRISPR/Cas9 Guide). The discovery of CRISPR/Cas9 has opened

countless doors for genetic science, providing a remarkably more accurate and cost effective method of editing the genome than ever before. By introducing the enzyme to a specific DNA sequence, CRISPR/Cas9 can be tweaked to target that same sequence in the genetic code of other organisms and “snip” it out like a microscopic pair of scissors. This gives scientists the capability to modify the genome in endless ways, and the scientific community is in a uproar about this revolution in the field of genetics.

Many people, ranging from scientists to politicians, are extremely optimistic about the immense benefits that the human race can reap from this tool. Ronald Green, Professor for the Study of Ethics and Human Values for the Department of Religion at Dartmouth College, wrote at length about the boundless potential of genetic engineering in his essay, “Building Baby From Genes Up.” Green recognizes that CRISPR could spell the end of several genetic disorders that plague the human race. This capability is both incredible and relevant for the modern world, considering that thirty-percent of children admitted to hospitals suffer from some form of genetic illness (Lucassen). Green mentions dyslexia, a common genetic disorder characterized by a difficulty reading and recognizing words, and its possible eradication in the coming years (“Building Baby from Genes Up”). A recent example of Green’s hopes in action hails from a lab at Temple University in Philadelphia. A team of the Temple University Health System has just managed to use CRISPR/Cas9 to edit HIV out of infected T-cells, the immune system cells that are targeted by the HIV virus. After the virus was removed, the cells were able to continue normal function and divide into other healthy, productive cells (Davis). HIV is one of the most debilitating viruses known to the modern world, and CRISPR’s ability to remove it from a

person's body is a testament to its value to society. Green, however, sees beyond the world of medicine and looks into CRISPR's effects on the social realm.

Green takes a step further than most, arguing that CRISPR could decrease social gaps and oppression by removing the genetic disadvantages that biologically separate people. In this way, Green feels that CRISPR could be an instrument of social equality. To him, taking advantage of the human genome is an empowering process, and he makes the claim that, "Knowing more about our genes may actually increase our freedom by helping us understand the biological obstacles -- and opportunities -- we have to work with" ("Building Baby from Genes Up"). Freedom, however, is exactly what many people fear that genetic engineering will take away, and a wave of opposition toward gene editing has been stirred up for this exact reason. These opponents share a concern that genetic engineering will only build mankind up for a great fall, and this criticism is very well-grounded when considering the extent of the power of genetic modification.

Among those who fear the fall, one of the most outspoken is Brendan Foht, an assistant editor for the *New Atlantis*. In one of his many articles discussing the ethical issues that he finds with genetic engineering, Foht articulates concern that parents may use genetic technology to determine the fates of their children. Rather than the unconditional love that he believes holds the relationship between child and parent together, the connection will be based upon a quest for perfection from the parent and constant pressure on the child to live up to the expectations that have been written into his or her genetic code ("The Case Against Human Gene Editing"). This fear is shared by Michael Sandel, a renowned political philosopher and professor of political philosophy at Harvard University. In his book, *The Case Against Perfection*, Sandel writes, "By

choosing in advance the genetic makeup of a child, the parents consign her to a life in the shadow of someone who has gone before, and so deprive the child of her right to an open future” (*The Case Against Perfection* 6-7). Sandel expresses concern that children, under the thumb of genetic engineering, will have their futures predetermined by their parents. Today, parents live vicariously through their children without the aid of genetic manipulation, and the opportunities for children to have their futures delegated to them before birth with the supplemental power of gene editing is indeed frightening and plausible.

This seems to be the opposite effect of what Ronald Green proposes as the result of the application of genetic engineering to the raising of children. Rather than being liberated through gene editing, children’s futures are dominated by the tools that genetics have supplied to their parents. The autonomy of individuals has been a priority for American citizens since the nation’s beginnings, thus this issue is very relevant for the American people at any period in time. Freedom is sacred in the United States, and genetic engineering may offer a very direct way around it. If freedom is compromised, then discrimination has the perfect opening to once again rear its ugly head.

This is, in fact, one of the concerns that genetic engineering’s opponents hold in the forefront of their minds and arguments. Robert P. George, Professor of Jurisprudence at Princeton University, said in an interview with the *Independent Journal* that, “The pursuit of genetic equality will erode our willingness to treat those who are genetically impaired as equal” (Rupp). George feels that by actively seeking to end the differences between people through a genetic approach, we will be predisposed to look down on the people that *do* have genetic differences and who do not have access to this gene editing technology. This seems to be the

polar opposite of Green's optimistic fantasy, which testifies to how unpredictable this new technology can be. American citizens in this age are taught to embrace diversity under the understanding that all people are inherently equal, but it seems that with the adoption of genetic engineering, society may be asserting that people are *not* inherently equal and need editing of the most central part of their being in order to be made "the correct way." History has shown that a mindset such as this can bring about some of the world's greatest tragedies.

In his article, Foht expresses his fear that genetic engineering could bring about a movement to oppress the genetically disadvantaged, citing the sterilizations that occurred during the Progressive Era as an example ("The Case Against Human Gene Editing"). Hitler's Nazi regime stands as another exemplar of the discrimination that can arise when one group feels superiority over another. It may very well be that genetic engineering will be wielded as a tool to ostracize those who are deemed inferior. Michael Reiss and Roger Straughan, co-authors of *Improving Nature?: The Science and Ethics of Genetic Engineering*, also bring up the possibility of discriminatory attacks upon the LGBT community amidst the search for a gene that contributes to a person's sexual preference (Reiss and Straughan 212-213). A tool like CRISPR/Cas9 has the power to undo decades of progressive effort and must not be used in careless, superficial ways. Some, like Foht, feel that this power should not be wielded by any man, and instead should be cast into the waste bin of all of man's other mistakes. Men and women like Foht, however, fail to take into account the true extent to which genetic engineering could change mankind for the better.

For genetic engineering to be disregarded, the human race must be content with its current state of existence. History has also shown, however, that the human race is *never* content

with its current state, and it consistently makes attempts to better itself and its environment. CRISPR could be one of mankind's greatest breakthroughs, but its potential is too unstable to be used without regulation. Although genetic engineering is not yet ready for human application, the human race needs to begin preparing for the day that it is rolled out of the labs and into the hands of the public. George Saul, in a lecture on genetic ethics in 1976, argued that problems are never expected, and so regulation is needed beforehand to prevent complications from becoming a reality ("Genetic Engineering: Source of Hope and Concern" 18). In the realm of gene editing, this could not be more true.

Some may find solace in the fact that genetic engineering is not yet advanced enough for direct usage in the human body. Labs in China have made multiple attempts at removing diseases from the genomes of non viable human embryos, most notably the gene responsible for the inherited blood disorder, Thalassemia. Though the scientists were able to achieve their desired results in some cases, a majority of their efforts resulted in the destruction of the embryo or the removal of incorrect genes ("Antibodies Part 1: CRISPR"). Nevertheless, society cannot remain comfortable with its current level of limits for this technology, as the U.S. has a miniscule amount of limits placed on genetic engineering compared to other developed nations (CGS). These limits must be updated if the U.S. is to prepare for the genetic revolution that is about to erupt.

The current levels of regulation for genetic engineering in the United States are flimsy and outdated. The nation is in dire need of control for this technology before the power of genetics becomes indomitable. The field of genetics is growing at a rate faster than humanity can get a moral grasp on, and humanity needs to create regulating bodies that can account for this

growth. Not only that, but the regulating bodies that are in place now are due for a makeover, because CRISPR/Cas9 not only brings ground-breaking scientific capabilities, but it also gives scientists new ways of working around the old regulations to reach these capabilities without the ethical consequences in mind.

The fervid debate that defines the world of genetic engineering truly branches with regard to what society's next step should be. Those who agree that gene editing should not be shelved do not, however, agree on where to start with regulation. The Northwest Resistance Against Genetic Engineering has made the claim that the United States will need to make a complete societal consensus on the proper usage of this technology: a compromise that every citizen can agree on (Glenn). Though this seems to be the ideal next step, it is a mere pipedream. The nation will never be able to reach a full, unexpurgated conclusion as to when genetic modification is warranted and when it is not. Due to this unfortunate fact, America will need organized bodies of people to regulate the use of genetic engineering in place of every single citizen, and this body just so happens to already exist: Congress. Yet despite genetic engineering's decades-long ominous presence, Congress has not taken any action to monitor its growth and usage.

Ex-Vice President Al Gore discussed Congress's role in the realm of genetic modification in his 1985 paper, "A Congressional Perspective." He points out that, during the Congressional session of 1977 and 1978, Congress was introduced to sixteen different bills involving recombinant DNA, yet Congress took no action upon any of them. Gore then goes on to say that, "The Asilomar Conference, which led to these developments, and the existence of the RAC, are extraordinary examples of the willingness of the scientific community to regulate itself in the face of scientific uncertainty" ("A Congressional Perspective" 15). According to Gore, Congress

has neglected to act due to the willingness of genetic scientists to regulate their own activities. Leaving the regulation to the scientists, however, is extremely dangerous.

If scientists determine what work is acceptable and which is not, they have the ability to deem any action that they take as “beneficial” or “necessary” for mankind, and bias will overcome regulatory responsibility. George Saul also comes to this conclusion, culminating his lecture with his belief that the ethics of genetic engineering cannot be left up to the scientists to decide, but rather groups of educated individuals wielding a sense of morality juxtaposed with knowledge of the genetic field ("Genetic Engineering: Source of Hope and Concern" 17-18). Foht shares this conclusion, claiming that scientists tend to avoid moral obligation in favor of blind advancement ("The Case Against Human Gene Editing"). So, because scientists should not be left to regulate themselves, and Congress feels no obligation to intervene, the American people are left to flail in a genetic dilemma.

Congress's lack of action is disturbing. In his lecture, Saul expresses identical concerns to those of the modern era, and that lecture was delivered in 1976. For 30 years, Congress has made no motion to silence these fears, and is unlikely to do so without a direct call for action. Most of the revulsion toward the genetic editing of humans stems from issues that are of direct Congressional concern. Many of Congress's bills have been passed to prevent discrimination and oppression in American society, and if the application of genetic technology to humans has the potential to create discrimination, Congress has an unquestionable duty to take a stand. Likewise, a sizeable portion of Congress's legislature has been passed to protect the freedom of American citizens, and if gene editing could potentially take freedom away from children in the United States, then Congress cannot pass the responsibility onto the scientists supplying the tools of this

subjugation; it must take action of its own to guarantee a future of equality and progression in this sea of ethical turmoil.

The perfect legislation to tame CRISPR/Cas9 is beyond comprehension due to the fluidity of the field of genetics. However, any legislation passed by Congress for the purpose of bridling genetic technology must prohibit the use of genetic engineering in a way that will affect a human's germline, or all subsequent offspring of that person. In other words, the use of eugenics, a branch of genetics dealing with the genome of embryos, should be outlawed, as any gene manipulation done to the genes of an embryo will become a permanent change to that embryo's line of offspring. These changes could then have unpredictable consequences to the evolution of the human species (Antibodies Part 1: CRISPR). Likewise, genetically altering an entire line of people could separate them from the rest of society similar to the way that race has separated groups in the past; people will again be distinguished from one another based on a characteristic that was bestowed upon them before their conception and is out of their control. The issue of freedom seems to come into play as well, giving Congress further incentive to begin making a move. Affecting the germline is certainly a recipe for disaster, but Congress must also create preventive measures for the abuse of genetic engineering as a cosmetic tool.

The idea of "designer babies" appears to be a prevalent phobia when it comes to the adoption of genetic engineering. Fears range from parents viewing their children as objects to the rise of distinct subspecies of humans, and these fears are very plausible. As such, Congress must pass legislation that accedes to the use of genetic engineering solely in cases of scientific research and medical need.

In terms of scientific research, genetic engineering should only be used upon consenting parties in ways that do not affect the germline, or upon non-viable embryos that will not develop into human beings. Of course, the use of genetic engineering on embryos is a debatable topic and a beast of ethical questions in and of itself, but in accordance with the current laws surrounding the use of embryos, I feel that it is acceptable.

In terms of medical need, genetic engineering should be employed to eliminate a genetic disability or mutation that would otherwise hinder a human organ or bodily system from functioning at a capacity that it would otherwise function to accomplish its purpose. These abnormalities may range from Parkinson's to near-sightedness, and genetic engineering must always be employed at the inflicted person's discretion in each case. Nevertheless, this change should not be applied to embryos in accordance with the proposed regulation of eugenics, as this change could have unknown and dire side-effects. These two cases are situations in which the benefits of gene editing outweigh the possible consequences and are unlikely to cause oppression, discrimination, or chaos within family life. Aside from these two caveats, this type of legislation will mainly serve to prevent the abuse of genetic engineering for superficial purposes.

CRISPR/Cas9 should not be exploited as a method of child customization or an augmentation medium. Editing the physical appearance of humans is an ability that, though seemingly harmless, could cause implicit and explicit biases to manifest into discriminations represented by the very physical being of the next generation. These surface-level changes serve no real purpose other than the fulfillment of parental preference and thus do not outweigh the risks associated with the use of gene editing. Along the same lines, legislature should prevent the use of genetic modification as a shortcut for hard work.

Parents want the best for their children, and people always want to better themselves. Genetic engineering, however, offers a hazardous shortcut for improvement. Humans may be tempted to simply edit intelligence or increased muscle strength into their genome, making those who can afford such technology genetically superior to those who cannot. Money, on its own, creates enough of a gap between groups in the modern world, but genetic engineering could create a chasm between them. Gene editing could, in turn, create a lower class of “genetically disadvantaged” people, erecting a caste system that is truly biologically based. Without this type of legislature as the basis for regulation, CRISPR/Cas9 could cause societal chaos on levels never seen before. However, Congressional organization on its own will not be enough to monitor the accelerating growth of the genetic field, and so Congress will need to instate organizations that function as review boards to effectively manage the usage of gene editing and enforce Congressional regulation.

Institutional review boards are a standard at any institution conducting research, weighing the benefit against the cost for a proposed study and deciding whether it has authorization to be carried out or not. Review boards such as these are needed to enforce the legislature passed by Congress at a more local level, as the lines between what is acceptable and not acceptable with legislature can be blurry and require a mediator that is close at hand. Ultimately, these boards are the arbiters of genetic engineering and the main warden against the abuse of gene editing. These calls to action may seem somewhat farfetched and difficult to attain in the short period of time that I believe society has been given to get a grip on gene editing, but it is comforting to know that the movements for these changes are already in motion.

The debate over genetic ethics has been a regular occurrence for decades, since the beginning of genetic engineering's conception. The Clothier Committee, a national committee that meets to discuss issues of medical and pharmaceutical concern, met in the UK in January 1992 to discuss the ethical issues involved in genetic engineering, coming to the consensus that gene editing did not pose any new ethical concerns (Reiss and Straughan 212-213). Though the committee deemed genetic engineering as a benign tool in 1992, it is vital that these meetings are still made regularly, and thankfully, they are. There have been a numerous amount of other conferences in cities around the globe that revolve around the ethics of genetic engineering, such as the conference in Asilomar, California (Gore 15). In regards to already established organizations, many scientists are urging the RAC to expand their regulations to encompass the new abilities of CRISPR/Cas9 for gene editing (Reiss and Straughan 214). University administrations, such as those of the School of Biological and Chemical Sciences in the University of Greenwich, are even incorporating genetic ethics classes into the science curriculum to educate young scientists about the moral aspects that a field as ripe with potential as genetics carries with it (Lucassen). At this rate, it very well may be that genetic engineering could be used as a force solely for good.

The benefits of genetic engineering are intertwined with grievous opportunities for misuse. Congressional regulation and review board intervention make up an integral basis for the proper use of gene editing in modern society. With these components in place, the field of genetics has the freedom to grow in a regulated environment that will keep it from accelerating out of control. Science is advancing faster than our moral understanding, and with regulation put

into place as soon as possible, human morals will, for once, have the opportunity to catch up before it is too late.

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