BioHacking

Biological Hacking And The Future of Homo-Sapien

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Abstract

Abstract is written last.

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1. Introduction

Introduction here.

2. Background

Selective breeding of plants and animals has been practiced since prehistoric times (Buffum). Species of wheat, rice, and dogs are different from their wild ancestors. Maize, i.e. corn, required especially large changes from teosinte, its wild form, and was selectively bred in Mesoamerica. Sources as much as 2,000 years old give advice on selecting animals for different purposes, and these works cite still older authorities, such as Mago the Carthaginian (Lush). These old methods are clumsy and imprecise. We would breed species together in the hopes of generating some desired phenotypic trait. Some of our other methods were quite outrageous. We would bombard plants with radiation, find the rare plant with a desirable trait, e.g. seedless grapes, and then produce more of that plant.

With the invention of techniques around Recombinant DNA, we developed Genetically Modified Organisms, i.e. GMOs. These include Golden Rice (Xudong et al.), herbicide (Funke et al.) and insect (Paine et al.) resistant crops. Recognizing the power of Recombinant DNA, the scientists involved congregated at Asilomar in the early 1970s to establish principles to ensure the safety of this budding technology (Berg et al.). However, there was no public engagement from the start and so there is still much fear among the public. Thus, the science has not realized its potential.

With animals, we have bred swine for meat (University), horses for performance (Evans), and pets such as dogs, cats, and birds. In 2013, researchers at the University of Istanbul created glow-in-the-dark

rabbits (Rojhan). Sea jelly genes were engineered into the bunnies' genomes, granting them luminescence. These bunnies were bred in an effort to create animals capable of producing medicines in their milk. We have continued such genetic experimentation on animals, with mice being the chief test subjects.

Our first steps down the path of human genetic engineering have been with In Vitro Fertilization. IVF involves the extraction of human gametes after which a small number of fertilized embryos are created in a lab. After some time, these are implanted in a womb with the hope that some will take root and a child will be borne to term. The first IVF pregnancy was reported in 1973 (Kretzer et al.) but it resulted in an early miscarriage. The first IVF birth occurred in Oldham, England on July 25, 1978 (Steptoe and Edwards). Since then IVF has grown in popularity. IVF births account for 2% of the births in the United States, 5% in Japan, and 10% in Norway and Denmark (Metzl).

With the completion of the Human Genome Project, the cost of sequencing is trending towards negligibility (Wetterstrand). With this ability to cheaply read our genomes, we are starting to demystify our biology. Among other developments, we have learned how to identify Down Syndrome during pre-natal screening (Natoli et al.), and are able to diagnose various genetic disorders in fertilized embryos during IVF (Rycke and Staessen). We have also been able to identify and categorize over 5,000 single-gene-mutations, i.e. Mendelian disorders. These include sickle cell anaemia, color blindness, muscular dystrophy, cystic fibrosis etc. This has opened up choices for which embryos to implant through IVF.

In addition to reading genomes, we now have the ability to arbitrarily edit genomes. The invention of CRISPR/Cas9 has opened up the world of genetic editing (Zhang, Y. Wen, and Guo). CRISPR works on genomes much like a text editor works on strings. There is a guide-RNA, the cursor, that can be placed at any desired nucleotide. From here, an arbitrarily long piece of the genome can be cut and either left deleted or replaced by some chosen sequence of nucleotides. This lets us make extremely precise edits to genomes at the expense of little power and time. The near-term applications of tools like CRISPR include potentially curing all Mendelian disorders, while long-term applications include rewriting large sections of human genomes to make "designer babies". In fact, the first genetically edited babies were born in China in October 2018 (Harney, Kelland, and P. Wen). Dr. He Jiankui announced the birth in videos on YouTube saying that he edited the CCR5 gene to grant increased resistance against HIV to the two girls. The Russian

scientist Dennis Rebrikov has announced that he has five parents signed up for gene-edited babies (Cohen).

When we start talking of the human experimentation, the word eugenics comes to mind. The history of eugenics should terrify us. To make and extreme understatement, many jewish communities were on the losing end of a eugenics experiment writ large, gone mad. We must never forget the atrocities of monsters such as Joseph Mengele. We held the Nürnberg trials in the wake of the Holocaust. These trials shaped the international laws we have around human experimentation.

3. Viewpoints

Viewpoints here.

reactions to GMOs. abortion debates. reaction to IVF. gene-edited babies in china. national level cultures around this topic.

4. Opinion

Opinion here.

We expect our new phones to be better, faster and different from our old phones. But we imagine biology as fixed. This will change over the 21st century.

5. Conclusion

Conclusion here.

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