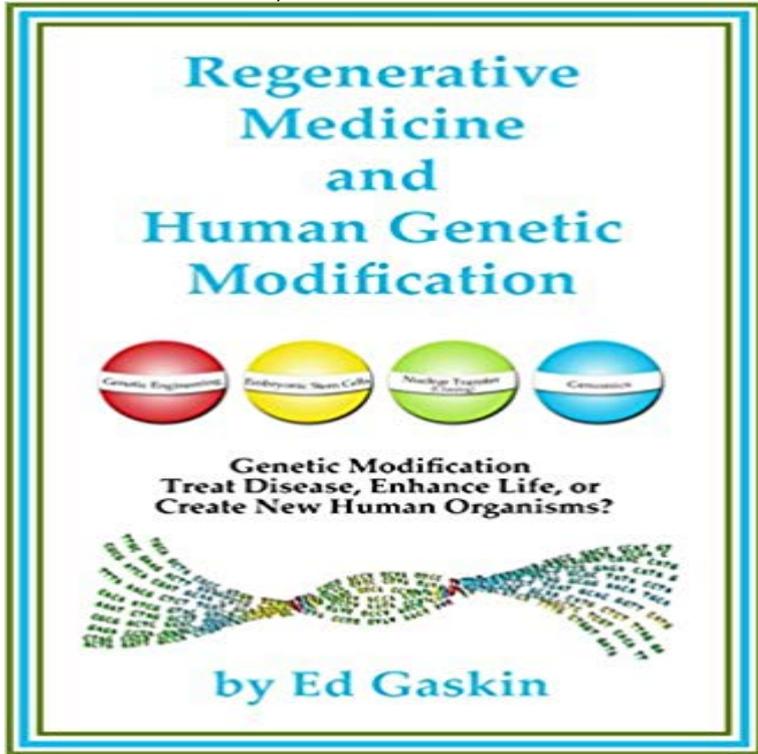


Regenerative Medicine and Human Genetic Modification: Treat Disease, Enhance Life, or Create New Human Organisms?



First Genetically Modified Babies Born, read the news headline. While not technically examples of genetically modified humans, the fact is when the babies were genetically fingerprinted they had the genes from two mothers and one father, which would alarm most people. One of the scientists involved said this is child's play, a mere tweaking of the reproductive process. Imagine before you Tinker Toys or Legos of all different sizes, shapes and colors. Imagine those pieces are actually genes from insects, plants, animals and people that can be used interchangeably to provide humans characteristics only comic book superheroes possess. Scientists have already taken the gene that provides the jellyfish its green color and inserted it into the DNA of a white rabbit to create a green rabbit. Scientists have taken the genes that enable spiders to make webbing and combined them with a goat's DNA as a way for the goat to make spider silk, a strong new fiber. We can do similar things with human DNA. Genomics provides us the equivalent of the Application Program Interface (API) for each human. Genomics, genetic engineering, embryonic stem cells, and nuclear transfer (cloning) independently have great promise and peril for us. There are numerous similarities between computer programming and genetic programming or genetic modification. Instead of programming with zeros and ones, we use C, T, A, G. We can reprogram DNA, cells and genes. The excitement with these new technologies is we can more effectively treat chronic diseases such as Parkinson's disease, osteoarthritis, osteoporosis, age-related macular degeneration, and atherosclerosis, which accounts for over 75% of medical costs. There are over 3,000 genetic diseases such as sickle cell anemia we could treat. We could treat infectious diseases such as HIV by developing an HIV resistant immune

system. However, there are also dangers. The same way computers and software can be hacked, genetic structures can be hacked. Genetic doping is possible. Because of the similarity between digital and genetic technologies, much of what we learned in the digital revolution can be transferred to the application of genetic modification and regenerative medicine. This similarity and the potential applications have not escaped the attention of companies such as Google who have announced major investments in these areas and are prepared to spend in the hundreds of millions for research. As a result of these powerful technologies we are on the brink of a genetic revolution similar in size and scope to the digital revolution (think biological versions of Google, Amazon, and Apple, but without any rules or guidelines). Because of the similarity, this revolution will occur faster, as many of the lessons learned in the digital revolution will be applied to the genetic revolution, and there is an abundance of venture capital looking for these types of game changing, disruptive technologies. Developing new genetic applications might be similar to developing cell phone apps sold at the iTunes store. These new technologies are patentable and potentially worth billions of dollars. We should not trust industry to do the right thing. There is a need to have as much discussion on the genetic modification of humans as we do on the GMO labeling of food. Currently we lack a national discussion, legislation or regulatory guidance on these controversial topics. We have not had a national discussion on bioethics since we debated the use of embryonic stem cells and cloning, over a decade ago. This book reviews the religious and scientific arguments, and refines the work of Norman Ford who was writing in the context of reproductive technologies, not the debates concerning embryonic stem cells and therapeutic cloning, and looks at where we are headed, with a focus on Dr. Michael West, a thought leader in this area.

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