

Preface

Los Angeles, a few years from now? You're walking down a city street. Dark skies drip with acid rain. Monolithic buildings covered in neon advertising dominate the landscape. Ahead you see a woman running toward you. She's being followed by a man with a gun. He fires at her and she crashes through a plate-glass window and hits the ground. She lies on the concrete, surrounded by broken glass and blood. Police ask the man for his credentials. He's Rick Deckard, a police officer known as a *blade runner*. It's his job to track down *replicants* (genetically engineered creatures composed entirely of organic substance) and "retire" them.

This is the world of Ridley Scott's *Blade Runner*. It's a dreary place, to be sure. People pack the streets tightly, and animals are all but extinct. Rain pours from the sky, and even when the sun is shining, it seems dark. Advertising screams, sometimes literally, from every direction. Flying cars—spinners—ferry police officers from place to place. It's a world of high technology and low empathy. Not a very *human* place to live.

Blade Runner is set in 2019, and while there may not be replicants running around the streets a few years from now, we may not have to wait long. After all, we live in an era in which the application of technology is relentless: the mapping of the human genome, life-support machines that extend metabolic processes beyond brain death, and countless other recent scientific developments have challenged our understanding of what it means to be human. But, while these technologies appear futuristic, the predominant effect of recent technological advances has not been to transform bodies in any significant way.

That is about to change.

Just like the sci-fi environments inhabited by bioengineered replicants, the intersection of technology and life will soon become a reality, and the specter of human genetic engineering, human cloning, and bioprinting will challenge the conception of what it means to be human even more. In *Beyond Human*, technology's infiltration of the organic—so familiar today in the form of genetic research and biotechnology—is presented neither as a transcendent savior nor as a maker of monsters. By presenting the trajectory of human genetic

engineering, human cloning, and technologies such as bioprinting, *Beyond Human* underscores the limits of the human body in a world where technology will soon threaten it with obsolescence. *Beyond Human* goes to the heart of human genetic engineering, cloning, and synthetic DNA manipulation to explain how replicant/bioengineered humans will be a reality—perhaps within a generation.

In *Blade Runner*, replicants can do all sorts of work. They're especially well-suited for jobs that are too hazardous for "natural" humans to do. Adverts for moving to off-world colonies promote the opportunity to own a replicant as an incentive. Genetic engineers design replicants and other life-forms using a combination of organic and synthetic materials. *Beyond Human* explores this theme by delving into the possibilities of gene doping in sports and designing ruggedized humans.

Should we be optimistic? *Beyond Human* asks what the existence of genetically engineered humans will mean for society and explores the possible relations between human beings and their replicant counterparts. Will the existence of genetically engineered and/or cloned humans result in a dystopian future similar to the one portrayed in *Blade Runner* or will the replicants of tomorrow be treated no differently than someone with a prosthetic limb?

Why the fixation on science fiction? Primarily because science-fiction writers make science entertaining and, while this is not a science-fiction book and I'm not a science-fiction writer, I decided to make the topic of human genetic engineering more accessible at the popular science level by referencing the subject material to science fiction movies with genetic themes. And, of all these movies, the darkly prophetic masterpiece *Blade Runner* stands out in the crowd because it served as the template for so many later films that dealt with genetic themes: *The Island*, *Gattaca*, *The 6th Day*, *Splice*, *Resident Evil*, etc.

Most people assume the term *genetic engineering* was coined recently by the scientific community—in the past 20 or 25 years perhaps? You'd be surprised. If you search for the term *genetic engineering* in the archives of the journal *Science*, you will find the following article: Stern C. Selection and Eugenics. *Science* 26 August 1949 110: 201–208. In Stern's article, the term *genetic engineering* is used in the breeding sense rather than the molecular biological sense, which isn't surprising given that Watson and Crick didn't publish the structure of DNA until 4 years later. Also, back in those days there was no scientific means to modify human genes, although genetics and eugenics had been hot topics in the 1930s and 1940s, thanks in part to the work of Hermann Muller, who won a Nobel Prize in 1946 following his work on radiation and the heritable mutations that could be caused by X-rays. Since then, the potential applications and implications of intentional genetic manipulation have supplied much plot-material for science-fiction novels and films.

In contemporary sci-fi movies, genetic engineering (*Gattaca*, *Blade Runner*, *Splice*) and cloning (*The Island*, *The 6th Day*, *Judge Dredd*) often compete for attention with other favorite sci-fi topics such as cybernetics (*The Terminator*, *Alien*, *Aliens*) and artificial intelligence (*Dark Star*, *The Matrix*, *2001: A Space Odyssey*). But what attracts film directors such as Ridley Scott to genetic engineering is not so much its scientific content as its relationship to more universal concepts such as heredity, reproduction, or replication, and its close connection to contemporary concerns concerning loss of identity (*The Island*) and authenticity (*Gattaca*) in a society increasingly dominated by technology (*Blade Runner*) and big business (*Splice*, *The 6th Day*).

Of course, in common with many films featuring science, medicine, and technology prominently, films with genetic themes have often been criticized on grounds of scientific inaccuracy. And, although not all cinematic treatments of genetics are wildly inaccurate, some may argue the cinema is perhaps not the best place to reference accurate information about the principles of human genetic engineering or cloning technologies. After all, if you watch the credits of many of these films, you'll notice that very few carry credits for scientific advisors, attention instead being focused on the modus operandi of genetic engineering or human cloning, rather than on the basic science of genetics. Sometimes the technologies described and portrayed bear little or no resemblance to any known genetic technology—take the suspect methods employed by the sinister Replacement Technologies Corporation to clone humans in the Schwarzenegger flick *The 6th Day* for example. But this doesn't mean nothing valuable can be gained from the study of sci-fi films in which genetic engineering plays an important part. It just means that to do so it is necessary to set aside strict criteria of scientific accuracy and realism. One of the reasons I chose to write this book the way it is written is because sci-fi films have a remarkable capacity for visualizing future scenarios in which science in general, and genetics in particular, plays an important role. If you want to learn about the intricacies of genome manipulation and if you want to understand the complex ethical arguments for and against human genetic engineering there are a myriad books out there. But not many of these publications venture into the unknown and speculatively guess about the ways in which current science and technology may develop. This is the beauty of the sci-fi film, which can reach and influence millions of people from all walks of life who may never watch a documentary on genetics. These films are, in short, a form of mass communication which the scientific world and those who write about it cannot afford to ignore. And, while some films, like *The 6th Day*, are cleverly contrived and slickly marketed mass entertainment products, a few, like *Blade Runner* and *Gattaca*, are works of considerable intellectual value, which is why their themes are revisited in this book.

In writing this book, I have been fortunate to have had reviewers who made such positive comments concerning the content of this publication. I am also grateful to Angela Lahee at Springer and her team for guiding this book through the publication process and gratefully acknowledge all those who gave permission to use many of the images in this book, especially EnvisionTec. Finally, I also express my deep appreciation to Deborah Marik, whose meticulous and unrelenting attention to detail greatly facilitated the publication of this book, and to eStudio Calamar, Figueres/Spain, for creating the cover.

Sandefjord, Norway
August 2014

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<http://www.springer.com/978-3-662-43525-0>

Beyond Human

Engineering Our Future Evolution

Seedhouse, E.

2014, XI, 153 p. 58 illus., 35 illus. in color., Softcover

ISBN: 978-3-662-43525-0