SUMMARY

ENDING AGING

AUBREY DE GREY

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Summary of “Ending Aging” by Aubrey de Grey

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Learn about the scientific breakthroughs that have unlocked the secret of aging.

Introduction

Aging is one of the pressing concerns of human existence. We worry about it constantly, from our obsession with fudging our age (how many times have you heard, “I’m turning 29 again next year!) to popular jokes (“Never ask a lady her age!”) to the insatiable market for anti-aging creams. It’s even a popular question in books, films, and games of 20 Questions: would you want to live forever? What price would you pay for immortality? Therefore, it is unsurprising that the study of aging would be a popular and revolutionary field, inspiring scientists to answer the questions that have fascinated humanity for centuries. And although this book can’t claim to hold all the answers, the theories expressed within these pages can contribute to the wider conversation on aging. So, let’s dive in and learn about the author’s groundbreaking research and the seven-step anti-aging program he’s created based on its results.

Is Aging Necessary?

Aging is one of life's most unavoidable elements, right? We accept the natural cycle of our lives as being bookended by "birth" and "death." And in-between-- although it's pretty grim to think about-- we accept that the aging process pretty much means we start decaying from the moment we're born. Indeed, according to this widely held worldview, every birthday, every year we accumulate, is another step towards aging and death. Consequently, we tend to accept that there's nothing we can do about it. After all, if it's a natural-- and unavoidable-- facet of the human experience, why bother trying to change it?

But what if we could? The author believes it's possible for modern science to attack the problem of aging in much the same way as we've treated disabilities: by finding a solution to treat it. Although de Grey acknowledges that it's unlikely that we will be able to "cure" aging entirely in the same way that we may not be able to find comprehensive cures for other ailments, he does believe that we can slow or impede the aging process. To this end, he has developed a program known as SENS which stands for Strategies for Engineered Negligible Senescence. Over the course of the next few chapters, we'll learn about the research behind SENS, what it hopes to accomplish, and how it can do so.

We'll also learn about the relationship between disease-bearing proteins and aging. Although this might be news to the average reader, the author has learned that certain proteins called AGEs work with problematic cell types known as "zombie cells" to attack human cells and contribute to the aging process. We'll also learn about how DNA mutations can lead to aging and what SENS could do to stop both these processes in their tracks.

Can we Prevent Aging?

An ounce of prevention is worth a pound of cure. We've all heard that old saying, right? Speaking from both a medical and economic perspective, it argues that preventing something from happening entirely is better than sinking time, money, and resources into damage control once it's already happened. And that's almost always true. However, when it comes to the aging process, the author-- backed by other leading researchers-- argues that preventing aging is either impossible or impractical or perhaps both. Why? Well, let's consider the impact in relation to other diseases that we treat through both of these methods.

For example, we don't have a cure for the flu. That's why we take a flu shot to prevent us from getting it. This serves two purposes by keeping us safe and allowing researchers to devote their valuable time and resources into studying the flu and ultimately finding a cure. This is a very effective method and a great choice for managing the problem of the flu. But when it comes to ailments like asthma, we can't really prevent people from developing it. In fact, statistics prove that many people will suffer from asthma whether they're born with it or acquire it as a complication resulting from another disease. And although we can't necessarily provide a one-size-fits-all "cure" for asthma, we can provide treatments that are so effective as to almost function as a cure.

For example, I struggled with severe asthma during my early childhood and was hospitalized many times as a result. But once I found the right physician and the right medication, my asthma became so manageable that I almost forget I have it! Now, I don't experience flare-ups or asthma attacks and I haven't been hospitalized for anything related to my lungs in over 12 years! So, if we consider the impact of asthma on my everyday life, it's almost as though I'm cured. As a result, I can experience relief from my symptoms without having to dig deeper and learn about the origin, cause, and effect of my illness. But that's not really an effective long-term solution for modern science and medicine, is it? After all, it's unlikely that the

medication which works for me will work for everyone who suffers from asthma. And although individual patients aren't necessarily responsible for doing all the research on their disease, someone should! Because that's how we develop cures. That's how we unlock scientific breakthroughs. And, perhaps most importantly, that's how we prevent certain diseases from affecting people in the future.

But of course, as we've already discussed, prevention isn't so easily accomplished. In order to prevent something, you need to know exactly where and why it started. And then you need the capacity to dissect and disable the factors that originated the problem. Unsurprisingly, however, this is a very complicated affair. And when it comes to aging-- and many other afflictions-- there's no such thing as one simple answer or a singular cause. That's because aging is the result of a variety of factors and it might be impossible to pin down all those causes and cut them all off effectively. That's why the second option--repairing the damage-- is our best option. To flesh this example out, let's imagine that we're trying to control the effects of aging on the body of a 50-year-old female.

This strategy wouldn't be able to double her lifespan or help her live to 100, but it would reduce the age-related wear and tear on her body. For example, if researchers could provide a therapeutic treatment plan for a woman to start at the age of 50 and she stuck to it for the rest of her life, by the time she reached 80, her body would only have suffered the damage common for a 50-year-old. That might not sound like much, but when we consider the afflictions that typically plague the elderly-- hearing loss, decreased eyesight, brittle bones, and memory loss, just to name a few!-- maintaining the health of a 50-year-old sounds pretty great! And if we can eventually do this for a 50-year-old, what if we could halt the effects of aging sooner? What if you lived your entire life with the health and vigor of someone in their twenties? The author believes that's absolutely possible and in the next chapter, we'll learn how!

How Mitochondrial Mutations Impact Our Aging Process

Now it's time to see what you remember from your high-school biology class! (If you're like me, that could easily be summarized with, "Not much!") Fortunately, we don't have to get into a science lesson here and you won't be graded on your knowledge. Instead, we're just going to take a closer look at the relationship between our mitochondrial DNA and aging. Put simply, mitochondria are rod-shaped organelles and you can think of them as the generator or power-plant for all of your body's cells. They fuel your body with energy, so we kind of need them if we want to live!

Unfortunately, however, while our mitochondria are the good guys, they also produce some unwanted side-effects. One of the worst side effects is something called free radicals. And although that might sound like a group of protesters, they're actually much worse in that they're designed to attack our bodies and-- as is the case with all the worst threats-- they attack from the inside. That's because our own cells generate free radicals (even though they don't really mean to). These problematic molecules are based on oxygen and if they only had a certain number of electrons, they wouldn't cause us any trouble at all. But because they're missing one critical electron, they remain in a highly reactive state, seeking an electron to bond with. This usually results in them attaching to the nearest available molecule and, as you might imagine, this triggers an unfortunate chain reaction.

Because the free radicals were never meant to be paired with their unwilling partners, a mitochondrial mutation occurs, and this sets off a chain reaction. This in turn damages your mitochondrial DNA and it works with the aging process because this mutation contributes to the deterioration of your cells. So, now that you know this, you might find yourself asking, "What can we do about it? If we know all of this, why can't we stop it?" The author has frequently asked these same questions and he believes we can find a solution. One possible option is something called allotopic expression, a type of gene therapy. Allotopic expression works similarly to

software programs which allow you to back up the files on your computer and keep them safe. The difference, of course, is that this form of therapy backs up our DNA and tucks it safely in the cell's protective nucleus. The nucleus then forms a barrier which keeps our genes safe from harmful free radicals and prevents mutations in our mitochondrial DNA.

Cell Waste Contributes to Aging

People produce some form of waste every day, ranging from bodily functions to trash to food waste. But it might surprise you to learn that inside your body, your cells are hard at work, and they also produce waste. Cells are also much better at recycling that waste than humans! Unfortunately, however, they don't do it perfectly; some of the detritus is still left lying around and-- as is the case with other forms of human waste-- that leftover trash can be detrimental. One problematic product of your cells' waste is called lipofuscin and your cells try to recycle it by using lysosomes. This allows them to dispose of a great deal of waste, but unfortunately, they can't get it all. So, the lipofuscin that remains clumps in your cells, which speeds up the aging process and clogs your arteries (to name just a few of its side-effects!)

So, how can we get rid of lipofuscin once and for all? Well, hold onto your seat because the author has a radical solution: graveyards! It might sound crazy, but studies show that-- because we accumulate lipofuscin until the moment we die-- it's only natural that dead bodies are rich sources of lipofuscin. But because lipofuscin is fluorescent and graveyards don't typically glow in the dark, this indicates that the lipofuscin present in dead bodies is being broken down.

Further studies have revealed that something is breaking it down and that something is called microbes! However, microbes live in soil, not in your body, so as that lipofuscin slowly bleeds out of its deceased hosts, the awaiting microbes in the ground start converting it into something they can use for growth. That's why the author theorizes that if we could somehow find a way to make microbes compatible with our bodies, they could start doing their thing within our cells! Of course, it would take a lot of research and experimentation before such technology would be available, but de Grey suggests that this is one possibility for naturally cleansing our bodies of lipofuscin.

However, lipofuscin isn't the only problem. In addition to the waste which builds up within our cells, amyloids build outside of our cells. Amyloids are groups of waste comprised of damaged proteins and they clump up in cells around the brain. This promotes the development of Alzheimers as the amyloids toxify and degrade our brain cells. So, even if we address the waste building inside our cells, the author reminds us that we have to eliminate those on the outside as well. How do we do that? de Grey posits that vaccination is one viable plausibility because it could work with our brain's immune system-- which already tries to filter out the amyloids-- to achieve a faster solution. These are some of the core solutions a program like SENS presents.

Altering Cells to Create a Better World

So, now that we've learned a little bit about the relationship between our cells and the aging process, let's take a closer look and learn how we can work with our cells to create a better world. The author begins by acknowledging that, since we lose our cells to disease, mutation, or gradual decline, our starting place should be the replenishment of our cells. Stem cell research is one great way of solving this problem, but-- as anyone who watches the news will know-- this is often a hotly debated topic. That's because only embryonic cells are so new and malleable that they can be used to form new cells. In fact, embryonic cells can be altered to become any type of cell the body might need, including those necessary for forming hearts, lungs, or muscles!

But of course, embryonic stem cells are only present in embryos that are in the very first stages of gestation. As a result, you can easily argue that no one wants to take cells from babies-- certainly not the living, breathing ones we hold in our arms-- or those that form in the lattermost stages of pregnancy. Rather, they can only be taken from embryos aborted in the very earliest stages of pregnancy. And despite the many medical and scientific benefits of conducting research with stem cells, this topic remains highly charged and heavily politicized. Many people, for example, are concerned that using these embryos is equivalent to taking a human life and that to do so would therefore be morally wrong. While the author does not attempt to offer a personal opinion on this matter or sway readers in one direction or another, one thing remains clear: until we can reach a conclusion regarding the matter of stem cell research, we will never be able to enjoy the many benefits this study could offer.

What Therapies Are Currently Available?

So, if we can't rely on stem cells at the moment and the technology to introduce microbes to our bodies is still developing, what therapies are currently available? The author's research has developed what he believes to be the next best solution and it's called "robust mouse rejuvenation" (or RMR). How does it work? It will start with-- you guessed it, mice!-- and de Grey applying his newly developed techniques to 20 mice as test subjects. He plans to start the treatment when the mice are two years old and follow the results of his therapy as they age, with the intent of measuring the effects over the span of 3-5 years. By beginning at the age of two, he asserts that this will provide him with a reasonable sample of the average wear and tear a healthy mouse can expect to experience because of aging.

Once his research has been successfully completed and he can report on the promising results, his hope is that he can initiate a conversation which will prompt medical facilities and other researchers to join him in his work. With the development of new drugs, advanced technology, and additional therapies, he believes that the medical and scientific communities could work together to effectively halt the aging process. If so, de Grey argues, maybe in twenty years, we'll be looking back with scorn on the days when we thought aging was unavoidable. Maybe by then, our grandparents will have the vitality that we do in our twenties. And maybe the infirmity of age will be considered a thing of the past.

Final Summary

For a long time, human beings have accepted aging and death as natural parts of the human experience. We assume that the human life cycle is naturally bookended by the two major events of birth and death. But although it certainly isn't possible to prevent death altogether, Aubrey de Grey believes that we can halt the aging process in its tracks and prevent it from destroying our bodies. By asking the right questions and investigating the right treatments, he argues that we can create a future in which aging is no longer a natural part of life.

By engaging with new advancements in modern science and technology-- like stem cell research and the author's own new RMR technique-- de Grey aims to decrease the damage aging inflicts on our bodies. To do so, he argues that we need to target the primary causes of aging, which include attacks on our cells from free radicals, lipofuscin, and amyloids. And if we can successfully shield our cells from attacks that promote the aging process, de Grey affirms that we can also protect ourselves from diseases like Alzheimers and cancer which also occur as a result of cell degradation, the build-up of toxic waste, and the destruction inflicted by free radicals. Therefore, we can conclude that if we want to stop our bodies from aging and accumulating new damage, we need to concentrate on therapies that protect our cells.