Podcast Episode 13: Cryonics part 1

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Teaser

Hey everyone! Welcome to the new episode of the Life Extension Podcast – technology & magic, society & business. For dying people cryonics is the last chance besides perhaps waking up in paradise. Listen to part 1 to learn about the practice and the science behind cryonics. Also understand the difference between cryonics and cryopreservation, as well as about shifting ethical judgements with regards to interventions into processes of life.

In this and the following episode I will discuss cryonics. Cryonics as part of the wider life extension industry has made an offer to us as consumers: deep-freezing and storage of our dead bodies with the hope to be reanimated in the future through scientific methods. This first part provides a short introduction into cryonics and involved processes, followed by the science behind it.

What is cryonics

So let's start with the main message of cryonics suppliers. First of all they define death differently. Life is defined by information patterns capturing mind, memories, and character traits, which is entirely stored in brain structures. Death is defined as the moment when this information is not recoverable anymore due to physical decay. While death is legally defined by clinical parameters like cardiac arrest, or an absence of brain waves, cryonics claims that all the important information in neuronal synapses by which life is defined is still present at the moment of legal death. The most urgent intervention to enable reanimation of a person in the future is therefore to preserve the biological body, and even more importantly the brain, as quickly as possible after legally declared death but before the decaying process has destroyed all that vital information. A medical team in stand-by mode will implement procedures to slow down the dying process, such as supplying oxygen through a mechanical blood pump, and covering the body in ice. After the body has been transported to the facilities of the supplier, the body will then be prepared for cooling down to minus 196 degrees C in liquid nitrogen, which is a temperature at which all biochemical processes will stop, enabling long-term storage without further information loss. The biggest challenge to freezing and thawing of biological materials is that water contained in cells would form ice crystals, resulting in rupturing cell membranes. For this reason suppliers will replace blood by an anti-freezing liquid (called cryoprotectant), which is supposed to protect body and brain cells from crystallization. Furthermore, the body is vitrified instead of frozen, meaning that water is transformed to a glass-like consistence instead to ice crystals. The whole process is called cryopreservation. This procedure carries two major risks. First, cryoprotectants are toxic. Secondly, it is not clear, if cryoprotectants penetrate and vitrification occurs in the totality of body and brain cells, because cells not covered by the procedure would certainly become damaged. In both cases repair procedures at molecular or nano-level would need to be undertaken after thawing – requiring new technologies not existent at present.

These are also major points brought forward against cryonics. Critics have tested current cryonic practices on animals and found that they resulted in major cell damage. Other experiments were successful to preserve synapses across the whole brain of a pig, but the procedure has to be conducted while the organism is still alive and it would kill it (Reilly 2020). Another major question is, even after potential cell damage could be successfully repaired with future technologies, and body and brain would be perfectly restored containing all its physically stored information, what would happen then? Would reanimation after decades or centuries be technically possible at all, and would the reanimated brain still have the same consciousness, the same personal identity? Would this still be me? So far these questions cannot be answered at all.

Science and applications of cryopreservation

At the moment there is no real scientific base of cryonics in the sense that the entire process of future resuscitation is entirely based on assumptions of future medical progress. True, scientific progress in the past has already allowed to treat many diseases and to live much longer lives. Now, the idea that even aging may be reversible through further scientific progress just leads to the next idea, that death may be reversible too. As stated by cryonics providers themselves, at the moment all cryonics procedures only focus on cryopreserving the body until future medical technologies will be available to bring the body back to life. At that time damage caused by former diseases and by the cryopreservation process itself shall be repaired, and the organism be rejuvenated (Best 2008). But even in cases that the body incl the brain cannot be reanimated in its pristine biological state, other technologies may be possible to reawaken the person then - as long as information stored in the brain could be retrieved. Claims by the cryonics industry always include "possibly", "cannot be excluded", etc. Those limitations make the industry's claims unscientific or pseudoscientific in the eyes of critics, of whom there are many. From the point of view of cryonics practitioners those critiques are narrow-minded. Fact is that cryonics is stretching the definition of what good scientific practice is supposed to be in radical ways. But even critics should admit that from the point of pure logic, the cryonics proposition has its merits: possibly is better than never. This reflects a philosophical idea called Pascal's wager. It says that we may not believe in the existence of god, but engaging in some religious activities is a good investment, because at least it includes the possibility of eternal rewards compared to nothingness or eternal damnation. Applied to cryonics this means that at least we have nothing to loose by trying.

Before taking a closer look at the science, let's distinguish cryopreservation from cryonics. Both practices occupy themselves with the preservation of biological materials at low temperatures with the purpose to bring them back to life at a later time. While cryopreservation is considered a non-controversial scientific activity, cryonics is highly contested, although from a material point of view, both do exactly the same thing. The difference lies in the ethical evaluation of the two practices. Freezing sperm, eggs, stem cells, tissues, or entire organs for storage and later use has become part of accepted biomedical practice in modern societies. But freezing and reanimating entire humans is overstepping boundaries of traditional turfs claimed by religions and other mythologies, which are equally in the business of governing access to spiritual transcendence. Interestingly, cryopreservation of human eggs and organs used to be contested too in exactly the same way as cryonics is today, which demonstrates nicely how interventions in processes of life can be subject to shifting ethical judgements with increasing market and institutional demand.

Nowadays serious work is ongoing in transplant, reproductive, and regenerative medicine, for all of which cryopreservation techniques are required and being developed. Logistical processes in biomedicine require that human biological materials be stored in a cryopreserved state in cell banks, organ and tissue banks, or sperm and egg banks between their production and actual use. The same is true for cryopreserved plant cells providing active ingredients to the biopharmaceutical industry (Nausch et al. 2021).

For all these industries cryopreservation is an essential technique, which is why research in freezing and thawing cycles, low-temperature storage, preventing ice formation in cells through cryoprotectants and vitification, and identifying better and less toxic cryoprotectants is officially recognized and funded (e.g. Jang et al. 2017; Manuchehrabadi 2017; Mao et al. 2018). Results of this research will benefit cryonics exactly in the same way.

Preservation of biological organisms in a frozen environment also occurs naturally in a few animals, incl the wood frog, the arctic ground squirrel, or some insects. They have naturally developed mechanisms to prevent their blood and body cells from crystallization, incl the synthetization of anti-freeze compounds, or to reduce water content in cells (Gruber 2018), to enable hibernation at sub-zero temperatures.

While there is sufficient scientific and practical evidence that freezing and thawing of human cells and tissues, or lower organisms like worms and insects is possible without causing damage, the technical hurdles to do the same with higher organisms incl humans seem too high to even be imagined by most scientists (Gruber 2018). However, the difficulty seems to lie mainly in the higher complexity of the mammal organism, not in some forbidding principle.

The first part of this discussion finishes here. The second part will be posted as a separate episode and discusses cryonics mainly from a cultural perspective. We will also touch on business and organization.

The bibliography of both parts appears in the script of the 2nd part.