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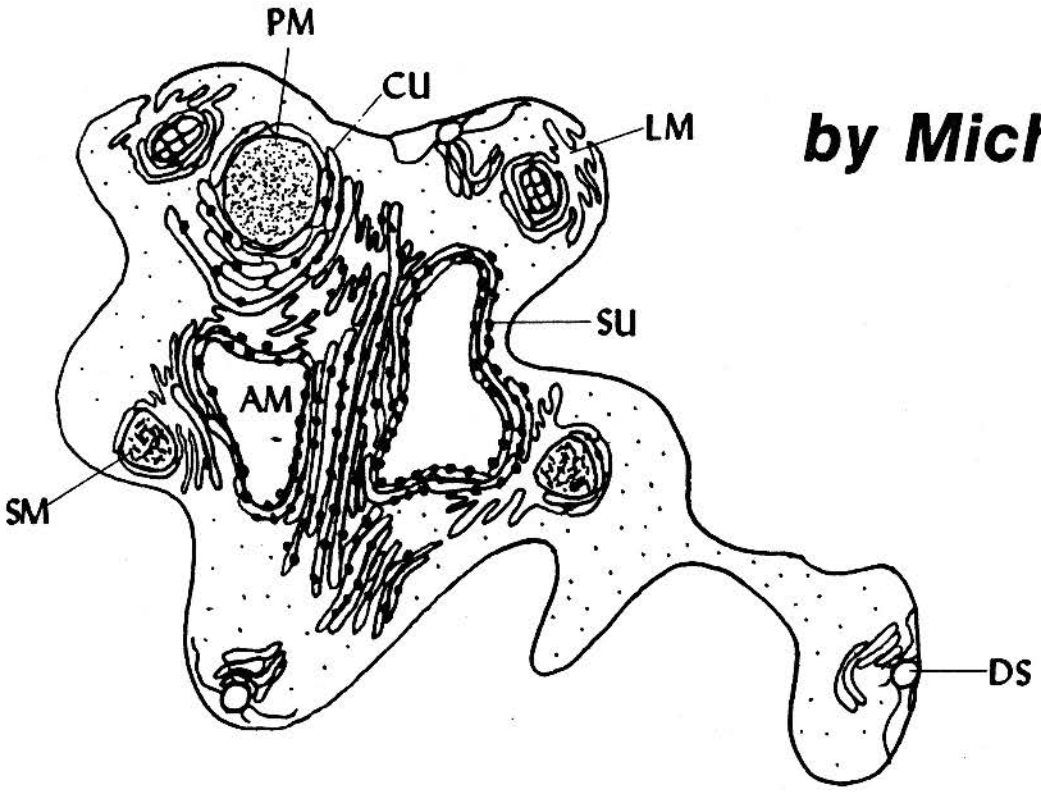
The Anabolocyte: A Biological Approach to Repairing Cryoinjury.



by Michael Darwin

ALSO IN THIS ISSUE

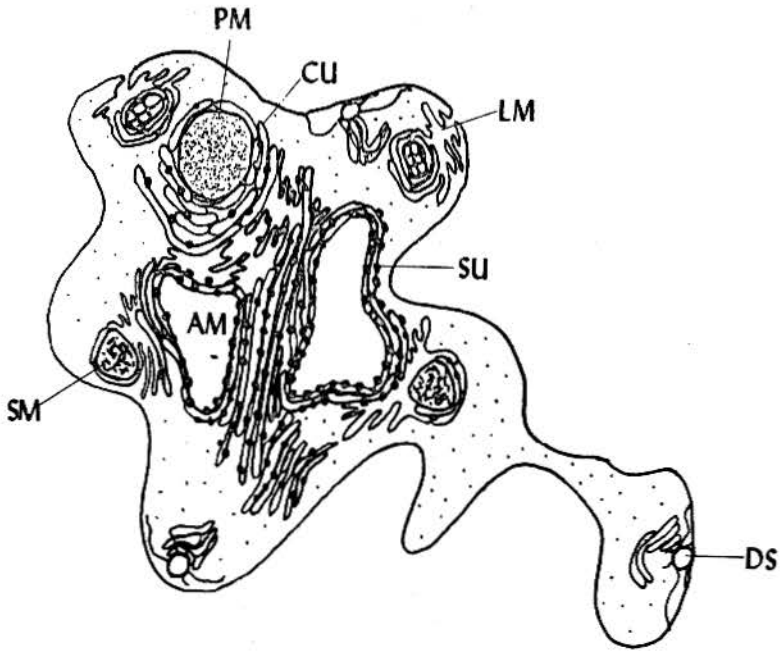
The Anabolocyte:* A Biological Approach To Repairing Cryoinjury

By Michael G. Darwin

Those interested in suspended animation in its current state must often ask the tough question: "What sort of magical repair process could possibly reverse the freeze-induced injury brought on by low temperatures?" There aren't any hard answers; only possibilities can be suggested and probabilities estimated from them. Such an estimation is still a pretty subjective thing, which this author could not put at other than "non-zero".

Actually, despite the fact that the operation of freezing someone with existing techniques depends upon some type of repair process being possible, remarkably little thought has been given the matter. Aside from a proposal by R.C.W. Ettinger in The Prospect of Immortality[1] that "... huge surgeon machines, working twenty-four hours a day for decades or even centuries, will tenderly restore the frozen brains, cell by cell, or even molecule by molecule in critical areas", and the suggestion by Jerome White that specially programmed viruses be used[2], the repair aspects have been totally neglected.

Before presenting my own proposed scenario, I would like to consider both of the above ideas. The robot surgeon idea has obvious practical limitations in terms of physical manipulation and economic/technological feasibility. Whether it is scientifically practicable is irrelevant; that it is economically beyond the resources of the contemporary patient is enough. The viral repair idea is another matter altogether and undoubtedly will be used to repair or "add to" cells. The only problem is that it will only prove effective when there is a metabolizing cell capable of implementing the genetic instructions carried by the specially programmed virus. Many cells will not have survived the freezing process with enough structure intact to resume high energy metabolism and carry on normal cell functions like protein synthesis and osmoregulation. We need a mechanism capable of repairing inactive or structurally "dead" cells. Another requirement is that this approach be compatible with known or foreseeable technology and be able to act within a reasonable period of time and at a reasonable cost in terms of resources. This is a very stringent set of conditions but, if we look to the emerging science of recombinant DNA technology, we may be able to "fabricate" some interesting solutions to the repair problem.



DRAWING 1: The Anabolocyte. The various parts are labelled: Conduit (CU); Program Module (PM); Synthesis Unit (SU); Storage Module (SM); DS and LM are sensing and proteolysis units respectively.

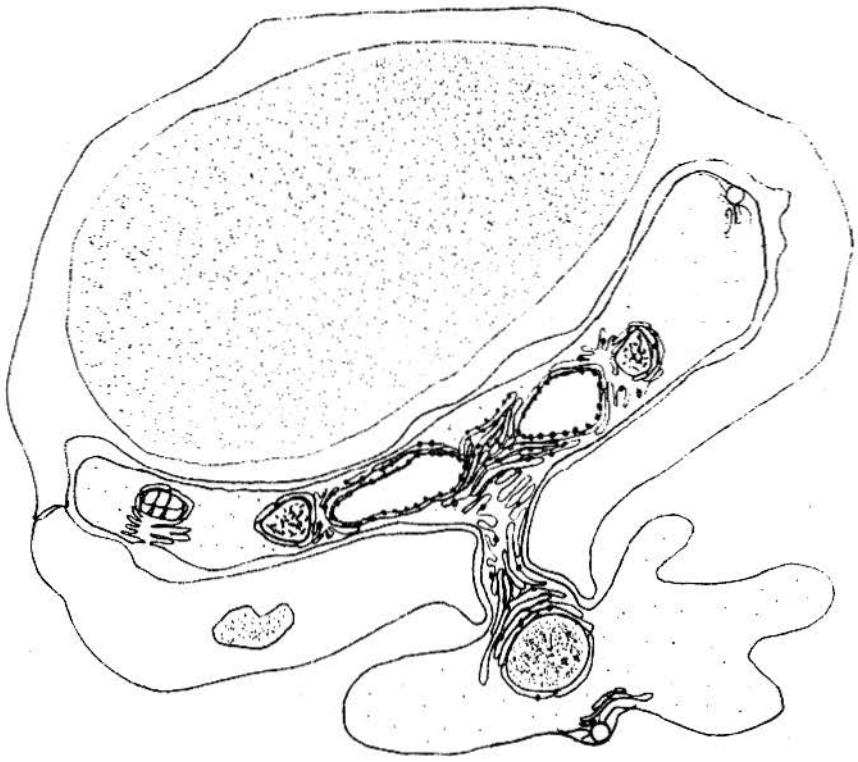
*Anabolocyte is a coined word used to describe the repair device discussed here. It comes from the word anabolism (anabolē Gr. meaning a rising up) or constructive metabolism and the suffix -cyte (kytos Gr. a hollow) which is a terminal combining form meaning a cell. Thus, an anabolocyte is any artifically engineered cell designed to effect biological repair.

If we start with something like a normal white blood cell and assume it could be modified in most any way, we could build an ultra-miniature, self-reduplicating repair unit. White cells are particularly good candidates for this type of transformation because they already embody several of the properties we are seeking. They have the capacity to move through the capillary walls to reach sites of injury and/or infection, they are compatible with human physiology, and perhaps more importantly, they have some (although very limited) capacity for attaching themselves to damaged or malignant cells to either repair them or donate a lyosome and destroy them.

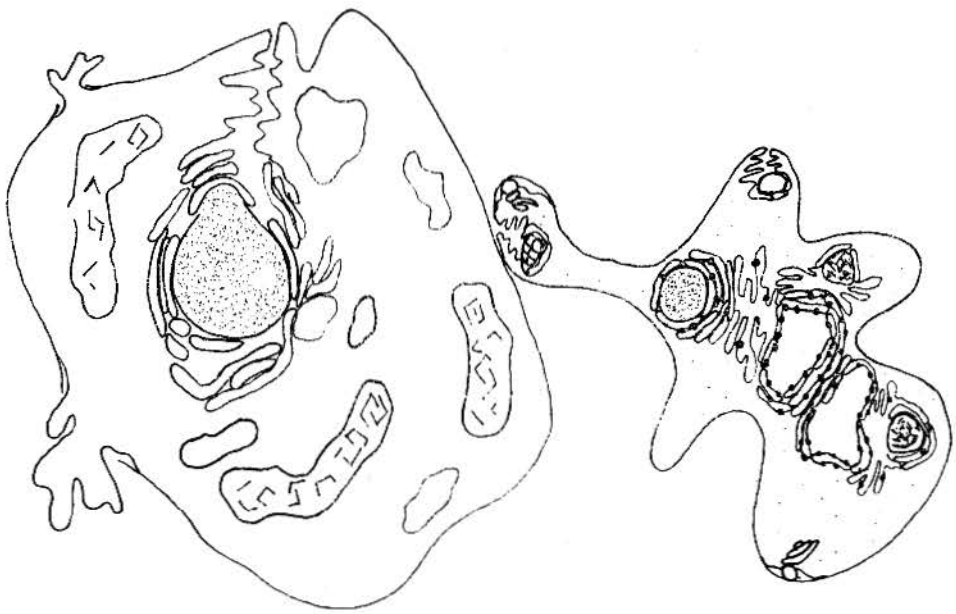
If we could modify white blood cells in any fashion , they could be used to crawl through the capillaries, seek out damaged cells (perhaps by following a "track" of lysosomal enzymes which are related to cryoinjury) and initiate a repair sequence.

The first of the accompanying drawings shows the anabolocyte. I have taken the libetty of assigning new names to the various intracellular organelles since in many cases they will behave differently from the original and may, depending upon our technological limitations, even be made of different materials than the original. "PM" is the Program Module and is the equivalent of the nucleus. The PM will be responsible for directing anabolocyte activities, from targeting through completion of the repair sequence. "SU" is the Synthesis Unit; it is here that new replacement organelles for the damaged originals will be fabricated. "SM" is the Storage Module which will contain high energy compound reserves and necessary raw materials that are not available on site. The Conduit, shown here as "CU", will bring newly-assembled macromolecules or building blocks to the Synthesis Unit. "DS" and "LM" are sensing and proteolysis units respectively. These last two units will be used to vector the anabolocyte and decompose damaged cell components for raw materials.

The anabolocyte may be designed to work at high subzero temperatures (say -15° or -20° C) in the presence of some inert antifreeze agent such as one of the silicon based glycols. In any event, it will be a highly specific piece of genetic engineering designed to act autonomously and in a very precise fashion.



DRAWING 2: The Anabolocyte breaking the junction of two capillary cells and squeezing out into the intracellular space. One of millions of such cells which would be at work in the patient.



DRAWING 3: The Anabolocyte attaching itself to a damaged cell. The cell has suffered catastrophically as a consequence of being ischemic, frozen and then thawed.

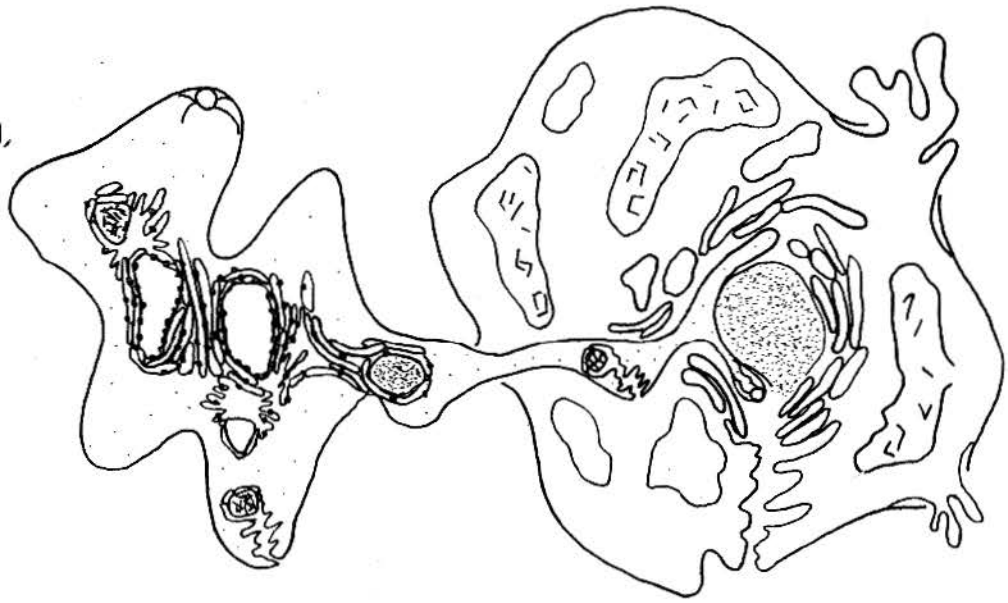
The second drawing shows the anabolocyte breaking the junction of two capillary cells and squeezing out into the intracellular space. There will, of course, be millions or even billions of these organisms released into the vasculature of the patient, each one targeted on locating and repairing a non-functioning cell, and most importantly, all acting simultaneously.

In drawing 3 we see the anabolocyte attaching itself to a damaged cell. This cell has suffered catastrophically as a consequence of being ischemic, frozen and then thawed. The cell membrane has been compromised, the ribosomes are diassociated, the cristae of the mitochondria have been disrupted and there is even nuclear vacoulization and rupture of the nuclear membrane. Clearly, this is what we could call our worst case injury. Looking at this mass of shattered structure, it is hard to visualize how anything could possibly restore it to normalcy.

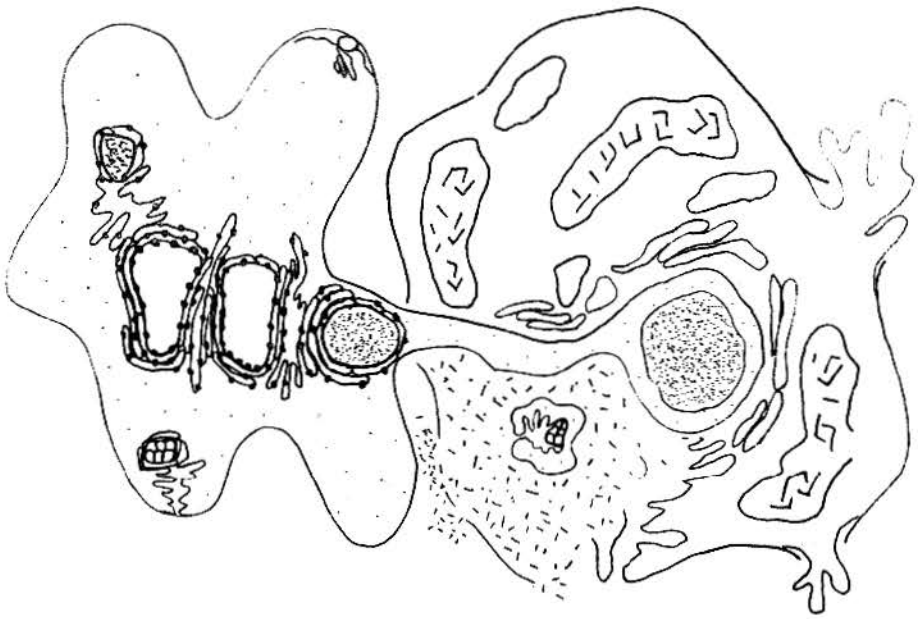
In drawing 4 the anabolocyte has begun the first step in the repair sequence, it has opened the cell membrane and has begun to appropriate nuclear information. At this juncture it is important to emphasize that this particular repair process is workable only for non-neuronal tissue. Nerve cells with information-containing dendrites and protein molecules would require an alternate repair sequence which would simply replace the defective metabolic equipment.

Once the information contained in the damaged cell nucleus has been sequestered, the anabolocyte begins pouring out proteolytic enzymes which digest the old damaged structures (drawing 5). Fortunately, nuclear information is very stable. By and large, genetic material is unaffected by conditions which are incredibly disruptive to other cellular structures. Even freeze drying, under the proper conditions, is not incompatible with the retention of genetic information.

Drawing 6 shows the beginning steps of fabricating a new cell. The anabolocyte begins elaborating new structure into the Synthesis Module, and actually step by step modifies its own structure and metabolism to conform to the blueprint contained in the original cell nucleus. The original damaged components from the "parent" cell are broken down into their component molecules and are used as raw



DRAWING 4: The anabolocyte has begun the first step in the repair sequence, it has opened the cell membrane and has begun to appropriate nuclear information.



DRAWING 5: The anabolocyte begins to pour out proteolytic enzymes which digest the old damaged structures after having sequestered the information contained in the cell nucleus.

material for synthesizing new structure.

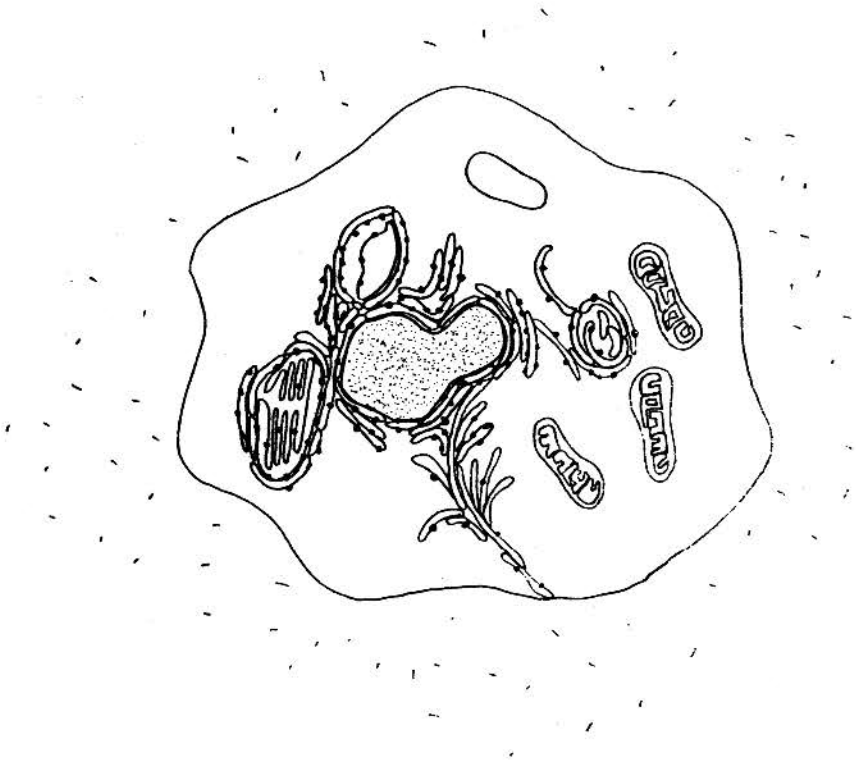
Finally in drawing 7, we have a new, operational cell, which is in every way identical to the original, and hopefully contains improvements such as prolonged resistance to ischemia, immunity from aging and viral attack and just perhaps, a total lack of susceptibility to cryoinjury.

REFERENCES

1. Ettinger, R.C.W. The Prospect of Immortality, McFadden-Bartell, 1961.

2. White, J. "Viral Induced Repair of Damaged Neurons with Preservation of Long Term Information Content". Second Annual Cryonics Conference, April 11, 1969.

DRAWING 6: The beginning steps of fabricating a new cell. The anabolocyte begins elaborating new structure into the Synthesis Module.



DRAWING 7: The finished product a new operational cell in every way identical to the original.

ABOUT

MICHAEL DARWIN...

Mr. Darwin has had a long-time interest in life extension, dating back more than a decade. Before breaking his ankle in three places, he was an avid skydiver. He currently resides in Indianapolis.