

## THE CHEMIOSMOSIS MESSAGE – A SIMPLE AND INFORMATION-RICH COMMUNICATION IN THE SEARCH FOR EXTRATERRESTRIAL INTELLIGENCE.

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A message transmitted to an extraterrestrial intelligence (1) or inscribed on a spacecraft should have a scientific content to demonstrate that our civilization accepts the primacy of science – showing that we can engage in objective communication, it should contain a technical insight of importance that demonstrates a willingness to communicate information, and it should be simple.

A depiction of the chemiosmotic theory is described that shows the basis of energy acquisition in terrestrial life through electron transfer and proton movement across a membrane. Chemiosmosis is the biochemical process whereby electron transfer through a membrane is used to pump protons from the inside of a membrane to the outside. The protons subsequently move back through the membrane to generate energy-rich molecules (in terrestrial life, ATP). The remarkable beauty of the system is its ubiquity in life on Earth and its use of two sub-atomic particles to drive energy acquisition as the fundamental basis of operation. Many molecules are required to operate the system, including cytochromes etc, but these are terrestrially-specific innovations that are not important to describe the basic physical process at work.

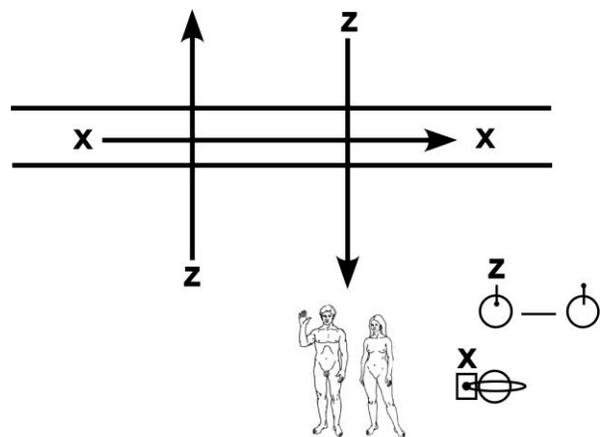
The effectiveness of the message lies in its simplicity – the depiction of only a membrane, an electron and a proton – which lends itself to decryption by the receiving entity, but it contains a large informational content about the nature of our society and the biochemistry of life on Earth.

If the intelligence recognises the system, they will know that they share a common biochemical basis with us; if they do not, they can attempt to create such a process in a lab – a technical insight from our civilization.

Other molecules have received attention in designing messages. Although the structure of DNA was transmitted in the Arecibo message of 1974, unless detailed chemical information is provided on such a molecule it is not clear how the molecule would work or whether it is in fact related to biochemistry. The details of the macromolecular structures involved in chemiosmosis are not required to depict the fundamental biochemical core of the system.

As with the Arecibo message, creating extraterrestrial missives, even if they are never received, makes us think about how to transmit scientific information across language and cultural barriers on the Earth, and how to create depictions of scientific processes and concepts that can be understood internationally.

**Figure 1.** Depiction of chemiosmosis message. Message shows electron transfer through a membrane (two parallel lines) resulting in proton exchange as the basis of life. The outcome of this exchange is biology depicted as humans (after the Pioneer 10 and 11 plaques). Electrons are depicted as in orbit around the centre of an atom (bottom right) and marked with the symbol 'X'. Protons are depicted as the hydrogen atom without electron for simplicity (symbol 'Z'). The hydrogen atom is shown in its two lowest states with a line depicting transfer from one state to the other (after 2). The hydrogen atom provides scale for the atom beneath it to show that that the atom depicts sub-atomic particles, not a planetary system.



**References.** (1) F. Drake (1992) *Is anyone out there? The scientific search for extraterrestrial intelligence.* Delacorte, New York. (2) C. Sagan et al. (1978). *Murmurs of Earth.* Ballantine, New York.