Presently discussed hypotheses on the nature of bioenergetic information

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WHAT IS BIOLOGICAL ENERGY OR INFORMATION?

In general the quality of any scientific discussion depends on the quality of the definition of the terms (termini) used to describe the facts under discussion.

A description of different scientific hypotheses on the phenomenon of bioenergetic information systems therefore demands an unambiguous clarification of the terms „biological energy" or „biological information".

According to the laws of thermodynamics (originally developed to provide the physical basis on which steam engines work), living organisms are open systems. In this connection „open" means that energy as well as substances is exchanged with the environment.

The fundamental laws of thermodynamics are summarised in the so-called basic principles of thermodynamics. The first of these concerns the amount of energy in our universe. It states that the amount of energy is constant. Energy cannot be created, nor can it be destroyed. This means that if steam is produced by burning coal, only the manifestation of energy changes.

This contrasts with the usual meaning of terms like energy producer (e. g. power station manager) and energy consumer (private households, industries, etc.).

The basic principles of thermodynamics are also applicable without restriction to living organisms. Therefore the term „bioenergy" is not a definition deviating from the laws of physics, but simply denotes the special and very complex energetic phenomena in living organisms.

In contrast, the exact definition of the term „information" is more difficult to define. In generalspeech information refers to something valuable, usually with a positive slant to the term. In this sense information is identified with order and verification. In fact, the dawning of the golden age (see the stock market) of our information society is based on this evaluation.

Surprisingly, all approaches to a physical-mathematical definition of information also come from thermodynamics.

The starting point is the usual differentiation in thermodynamics between a macrostate and a microstate. Consider for instance a closed container which contains one litre of air. The temperature of the air in the container can be measured. If the measurement value is 20°C, the statement „The temperature within the container is 20°C" describes a macrostate.

On the other hand it is well-known that the temperature depends on the speed at which the air particles (molecules) within the container move. I. e. the higher the average speed of the air molecules, the higher the measured temperature. The air molecules do not, in fact, have the same speed. The speed of the particles varies around an average. The speed distribution forms a bell curve called Boltzmann distribution after its discoverer. Since the number of particles in a litre of air is extraordinarily high on the one hand, and they continually change their speed through collisions on the other, there is a large number of different microscopic states that all result in the measurement of the same temperature. The number of possible microscopic states is a measure of the degree of disorder within a system and is called entropy. I. e., the higher the number of microstates subordinated within a certain macrostate, the higher the entropy, i. e. the degree of disorder.

The first attempts to define information through

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entropy go back to the founder of cybernetics, Norbert Wiener, and the mathematician Leon Brillouin, who came to the following conclusion:

„Just as the information content of a system is a measure of the degree of order in it, the entropy of a system is a measure of the degree of disorder."

Brillouin developed this concept of Wiener further and described it with the term „negentropy".
I. e. information is negative negentropy, i. e. negative nonorder, i. e. order.

This explanation sounds wonderfully plausible, but unfortunately it is untrue. The generally accepted information theory of the past 50 years showed that exactly the opposite of the statement by Wiener and Brillouin is true. The information content of a system is proportional to the entropy of the system, i. e. to the degree of disorder.

From this follows, by the way, that our information society is really an entropic society, a society of ignorance and disorder, at least in a physical sense.

The statement that information is closely connected to entropy, a measure of disorder, contradicts our intuitive understanding of information. Therefore I want to explain the basic idea with a simple example.

Let us consider two different substances like rock crystal and red wine.

Pure rock crystal consists of silicon (Si) and oxygen. The distribution of Si and oxygen atoms in space is always the same throughout the crystal, whatever its size. The crystal has a regular structure which repeats itself from the smallest elementary cell throughout the crystal. This is true of every rock crystal, whether it comes from the Alps, the Andes or from a laboratory.

The rock crystal has a high degree of order,
i. e. low entropy and therefore little information. (When one knows one rock crystal, one knows all of them.)

A glass of red wine is quite different. It contains at least 500 different substances, most of which have no chemical names. Moreover, its composition differs drastically according to the year, type of grape and place of origin. A wine expert is able to obtain a large amount of information from tasting the wine. Even if he does not know where the wine was pressed, he usually is able to identify the type of grape, possibly the year, the place of origin and even the location of the vineyard. Good wine noses can even determine whether the wine was stored on oak or not.

It is clear that both the disorder and the information content of a sample of red wine is substantially higher than that of a rock crystal.

From what has been explained so far, two basic characteristics of biological information systems may be derived:

1. Information is only defined when it is certain who speaks to whom in connection with what.

   Someone who usually drinks beer, for instance, is not able to differentiate a Pinot Noir from a Cabernet Sauvignon. He does not understand the language of wine.

2. Acquiring (obtaining) information is not the problem, since, as explained above, this process is linked to the increase of entropy and therefore demands no energy. The cardinal problem of a living being is to lose unnecessary and uninteresting information.

Try the following in illustration of this point. Enter the virtual temple of the information society, the Internet, and look for specific information. Apart from the fact that even the best search engines will only obtain a fraction of the available data, you will pass hours in reading pages of useless things in order to perhaps find the information you need.

In summary the following may be remembered: Two basic rules can be used to create a clear and generally accepted basis for assessing the customary hypotheses on, models of and intellectual approaches to the physical nature of bioenergetic information systems:

1. Hypotheses exclusively based on energetic phenomena, whether they be quantum fields, vital fields and/or morphogenetic fields, are irrelevant from the start, since energy in whatever form is never information itself.

2. Hypotheses whose exclusive basis is formed by more or less plausible statements on the location, availability and transfer mechanisms of information in biological systems cannot by themselves explain anything.

   At any point of their life cycle living organisms, from single-cell organisms to highly developed mammals, possess the necessary information for maintaining their vital processes.

   Explanations are only useful if they are aimed at phenomena caused by biological systems which process meaningless or wrong information pathogenically.

CONCLUSIONS

If we look at the different hypotheses on the phenomenon of bioenergetic information, it is immediately obvious that a immaterial over-all regulatory system is without exception assumed as information carrier. In order to describe such regulatory systems more carefully, all known models fall back on the concept of a physical field, e. g. quantum field, vital field, morphogenetic field, etc.

Of course it is possible that over-all regulatory systems exist in the form of energetic fields. However, verification is impossible according to the criteria for deciding or analysing described above, since none of the theories explain how these fields influence or control vital biochemical processes. I. e. the initial step of manipulation or change of such a field is far removed from a verifiable effect on the material base of an organism.

Consider the following example: The effect of external but very weak electromagnetic fields on melatonin excretion were proven several times with animal experiments (mice).

The observed effect, i. e. the change of melatonin concentration in the blood of the experimental animals, is far from a possible primary interaction between an electromagnetic field and living organisms. The question of how the first step of an interaction takes place has not been solved even partially by the so-called established sciences.

This is one reason for the extremely divergent opinions on the question whether electrosmog exists at all, and if it does, whether living organisms may be harmed by it. Recently these shortcomings were pointed out in important reviews (1, 2) in renowned scientific journals.

As long as there is no theory on the subject of bioenergetic information which makes statements on all intermediate steps from the regulatory system up to biochemical changes, a discussion taking scientific assumptions into account is not very helpful.

Therefore investigations are necessary to clearly explain the first step of interaction between a living organism and biogenic information-carrying electromagnetic fields. Questions like the following should be answered:

- „Which structural and biochemical changes occur when an organism interacts with a purely electrostatic field or a purely magnetic field?"
- „Can a primary effect only be observed when electromagnetic alternating fields are involved?"

Further, i. e. more complex interrelations between energetic regulatory systems and biochemical processes in living organisms can only be cleared up when questions like the above have been answered clearly and underpinned by experimental duplication.

My suggestion is therefore:

Work on the basics of the interrelation between electromagnetic fields and living organisms first. Depending on the results, an underpinned and logical model of bioenergetic information systems will result automatically.

If there is enough time left I will demonstrate that this is possible by using a practical example.

LITERATURE

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