LOGOS OR CHAOS by K.Potsch

Abstract

The aim of this article is to review the Laws of Thermodynamics for simple (physical) systems and by analogy formulate laws that describe the timely behavior of complex (living) systems.

Time Arrow

Another aspect of the Creation - Evolution debate is the question whether the development of life started from order 'logos' (Jn 1:1) and went downhill after the fall or from chaos and went uphill. Looking at some aspects of basic physical laws should give us some insight.

It is selfunderstood that we can travel back and forth in space. On the other hand time passes. Physicists talk of bidirectionality of space coordinates while the time coordinate reveals a one way character. Writers of novels (H.G.Wells: The Time Machine) and movie authors (Back to the Future) play with the illusion of travelling in any direction with time. We know from experience that all physical processes carry the time arrow - things (cars) and living beings (animals, humans) get older.



The conservation laws which we discussed earlier do not give us a hint of a time arrow. Nor can we conclude that there was ever a beginning. If we could find a physical law, found empirically or by theoretical considerations that includes the time arrow, this would indicate that there was a beginning.

Laws of Thermodynamics

The study of systems and their behavior with time started with the invention of the steam engine (thermodynamics) ~ 1865 (Helmholtz, Clausius, Nernst, Boltzmann). These men formulated the laws of thermodynamics (for closed systems) that take into accout the characteristics of the time coordinate:

First Law of Thermodynamics:

The total energy of the universe is constant. ($E_{tot} = const$).

This is the well known conservation law for energy. There are various forms of energy: potential, gravitational, kinetic (motion), magnetic, electric, chemical, nuclear, thermal etc. They can be converted into each other in theory without loss of energy, but in practice only with loss of energy.

Second Law of Thermodynamics:

The entropy of the universe approaches a maximum. (dS/dt ≥ 0)

This newly introduced quantity is needed to describe the development of systems. It is the long sought time arrow. The term 'entropy' is difficult to explain in everyday words: The easiest way is to relate it to the amount of usable energy of a system to perform work. It is an absolutly empirical law (derived from experience). In classical mechanics it is formulated in differential form where small changes - symbolized by the letter d - are considered: dS = dQrev / T. S is the symbol for entropy, Q stands for the amount of heat transfered during the process from one system to another and T is the temperature. In order for the '=' sign to be applicable Q has to be transfered in a reversible way (possible just in theory). The definition is in reality a differential equation which can be solved when one knows how the heat transfered depends on temperature and other physical variables.

In statistical mechanics (Boltzmann) uses a different approach: $S = k \times InW$, with S...entropy, W...thermodynamic probability (for specialists: i.e. the number of microstates that represent the same macrostate), k... Boltzmann constant. This formulation simply states that the higher the probability for a system to be in a certain state (condition) the higher the entropy is.

A Practical Example

A typical example shall illustrate the first two laws: the temperature equilibration of 2 bodies with different temperatures. (Readers who do not want to immerse in the math proceed to the discussion of the graphs)



The amount of heat stored in the reservoirs is $Q_1=c_1.T_1$ and $Q_2=c_2.T_2$. The amount of heat transfered between the two reservoirs is $Q=\Lambda$.gradT= Λ .(T₁-T₂). c is the heat capacity and Λ is the heat conductivity of the connection between the two reservoirs. The system of differential equations results from equating the change of heat in the reservoir to the amount of heat transfered:

$$Q = \Lambda(T_1 - T_2) = -Q_1^{-} = -c_1 T_1$$
$$Q = \Lambda(T_1 - T_2) = Q_2^{-} = c_2 T_2$$

For completing this system we need the initial conditions at time t=0: $T_1=T_{10}$ and $T_2=T_{20}$ with $T_{10}>T_{20}$. The solution is found to be

$$\frac{T_{10} - T_1}{T_{10} - T_{20}} = \frac{c_2}{c_1 + c_2} \left(1 - \exp(-Kt) \right), \quad \frac{T_{20} - T_2}{T_{10} - T_{20}} = \frac{c_1}{c_1 + c_2} \left(1 - \exp(-Kt) \right), \quad K = \Lambda \frac{c_1 + c_2}{c_1 c_2}$$

The equilibrium temperature is reached as time approaches infinity:

$$T_{\infty} = \frac{c_1 T_{10} + c_2 T_{20}}{c_1 + c_2}$$

The First Law is fulfilled with the fact that $Q_{tot}=Q_1+Q_2$. To verify the Second Law we have to calculate the entropy of both reservoirs assuming that the process is reversible meaning that no heat losses inside the system occur. Keeping in mind the sign of the transfered heat (- refers to heat flowing out of the system) we have to add the entropies of both reservoirs

$$\Delta S = \Delta S_1 + \Delta S_2$$

$$\Delta S_1 = \int_{t=0}^t \frac{dQ_1}{T_1} = -c_1 \int_{t=0}^t \frac{dT_1}{dt} \frac{dt}{T_1} = -c_1 \ln T_1 \Big|_{t=0}^t = -c_1 \ln \frac{T_{10}}{T_1}.$$

and finally arrive at

$$\Delta S = \ln\left(\left(\frac{T_{10}}{T_1}\right)^{c_1} \left(\frac{T_2}{T_{20}}\right)^{c_2}\right)$$

Entropy is connected with the loss of useful energy. The energy Q is transfered from the higher temperature level to the lower temperature level and therefore no longer able to perform work. The useful energy for performing some work is simply the difference between the amount of heat between the two reservoirs. As time approaches infinity this difference becomes zero:

 $\lim_{t\to\infty}c_1(T_1-T_2)=0$

The results of the just solved physical problem are displayed in graphical form:



Fig.1: development of temperatures T_1, T_2



time

Fig.2: development of usable energy and entropy difference

At the beginneng of the heat transfer process both reservoirs start out with the initial temperatures T_{10} and T_{20} . As time progresses the difference between the temperatures is levelled out (Fig.1). In another graph (Fig.2) we see the First Law fulfilled with the sum of the energies of the systems being constant. The usable energy is linked to the temperature difference and approaches zero with the increase of time. The Second Laws is also fulfilled because the increase in entropy reaches a plateau (maximum). Without imposing any restrictions on the process we assumed that the entropy at the beginning of the process was zero.

The entropy is defined in differential form. Therefore the constant of integration is left open. We do not know the size of entropy at the start of any process. To close the system of equations and in order not to leave anything undefined an additional law was formulated:

Third Law of Thermodynamics:

The entropy of a pure homogenous system at the beginning of the absolute scale of temperature is zero $(\lim_{T\to 0} S=0)$.

The Third Law tells us that the entropy always has to be positive (S>=0). The Second Law says that the entropy always increases with time (dS/dt>=0). If one moves the opposite way into the past. Then the value of entropy will always decrease until it reaches zero at a certain time. Further one cannot move. This time corresponds to a state of perfection (paradise?). All energy is available for useful work. Creationists call this the beginning - the creation of the universe.



Fig.3: Behavior of entropy with time

Downhill...

As we saw in the example of heat transfer, it is a natural process that energy is transfered from a high temperature reservoir to a low temperature reservoir. This experimental observation can be generalized to potentials (whatever they are and how they are defined). The flow follows the downhill direction from the higher potential to the lower one, like water from the roof to the drain. If we look at a system with multiple subsystems then it is a natural tendency that all energy differences between the subsystems will be leveled out. Examples for this are: the solar system (equilibrating temperature differences), U-tube (minimizing the potential energy), mixing processes, car, teeth, aging, inflation.

The Laws of Thermodynamics are formulated for simple (nonanimated) systems. Evolutionists generally do not accept the applicability of the Second Law for living (complex) systems. But what we see in nature (animated matter) are trends comparable to the one formulated in the Second Law. The observations are independent of the kind of system (open or closed):

nonequilibrium	=>	disappears	=>	equilibrium
differences	=>	level out	=>	equality
variety	=>	is destroyed	=>	monotony
order	=>	breaks down	=>	disorder
patterns	=>	are anihilated	=>	uniformity

All these processes have common features. It will be our goal to come up with some analogies (equivalents) so that we can equate terms from simple systems like energy, temperature, entropy with terms of complex structures/systems, so that natural laws can be formulated - hopefully with the time arrow being included.

Perpetual Motion

The pure definitions of the Laws of Thermodynamics are not very practical for 'everyman'. A good help are conclusions that can be drawn from them by constructing machines with certain features. Engineers always dreamed of frictionless machines that run endlessly. Such a machine of which there are two

kinds are called perpetual motion. The First and Second Law of Thermodynamics prove them to be unrealistic. If they were a reality one could call them the first and second 'flaw' of thermodynamics.

Perpetual motion of the first kind:

There does not exist a machine that performs work without energy being transfered to the machine.

A machine can be viewed as a system. If this machine performs work - which is a form of energy that is transferred across the boundary - it lowers ist energy content. Since the amount of energy remains at a constant level, the loss of energy has to be balanced from outside (First Law - conservation of energy). Or in other words: no machine can perform work without using up its internal energy.

Perpetual motion of the second kind:

There does not exist a periodically working machine that performs work by cooling off a heat reservoir.

The key word here is 'periodically'. The machine returns after each cycle to the same state (meaning energy content). This is required to fulfill the First Law. A working machine performs work. As it became clear in the previous example of the perpetual motion of the first kind the machine needs energy supplied from outside the system. The formulation of the perpetual motion of the second kind assumes that there is only one heat or energy reservoir present. Without a second heat reservoir the conversion from heat into work would be 100%. We know that this is not the case because wherever work is performed there is friction. A translation into practice is a car engine that converts the chemical energy of the gasoline - the gas tank is an energy reservoir - completely (100%) into motion (work). No heat would be produced and the passengers would sit in wintertime in the cold.

Unanimated and Animated Matter

The basic conservation laws are formulated for unanimated matter. Laws for animated matter can hardly be formulated since the complexity and the number of variables are enourmous. Evolution and especially Darwin postulate an uphill development for unanimated and animated matter, an increase in complexity that is dependent on information as we will see. The decision which model creation or evolution - is the one reflecting the reality can be made if we could find a law for the "time arrow". The Second Law of Thermodynamics gives us the "time arrow" for unanimated matter. Evolutionists deny the applicability of the Second Law to living systems:

Firstly, they deny that energy plays a significant role in living, complex systems. But it does, as can be seen from a list of fields/sciences where it is evident that energy is involved.

non-life sciences:

- cosmology
- astronomy, astrophysics
- geophysics, geology
- physics of the atmosphere

• oceanography

life sciences:

- biology chemical energy, information
- zoology chemical energy, information
- anthropology chemical energy, information
- ethnograpy information
- linguistics information
- sociology 'human' energy

Secondly, evolutionists claim that the Laws of Thermodynamics are formulated for closed systems. Living systems are open. They depend on food (yum!). But, energy transfer is just a necessary condition not the sufficient one.

The transfer of energy into an open system does not mean automatically an increase in useful energy or order. An example will shed some light on that question: Suppose there is a room with the windows open. The wind is blowing in, tossing the papers from the writing desk and even the books from the shelf. The things on the floor now have all the same (potential) energy level. Did this event increase the order? Nevertheless, energy was brought into the room, a necessary condition. (The books and papers were not elevated to the ceiling. In that case the increase in potential energy would be evident. The wind energy was to a great extent dissipated). To reinstall order into that room someone (with information) has to come in and put the pieces back in place.

The elements of a system must be arranged in a certain way - let's call it pattern - in order to see an increase in order. What is a sufficient condition? The key to it is information. Someone has to know the place or the way to arrange the elements so that an increase in order can be evident. The increase in order can only be possible if the system is an open system with respect to information. The information must have a source and that can only be a higher intelligence.

If the information is not provided for the increase in order then the system will change towards the state of maximal probability - disorder. Maximum disorder is reached when two elements of the system trade places and the entropy does not change. An approach which is taken in statistical mechanics. In the classical approach all differences in energy or temperature will disappear. That means that all elements must be at the same temperature or energy level.

Thirdly, an equivalent 'Second Law' for living systems has not been formulated yet in terms that describe the behavior of those systems in an easy way.

The formulation of an equivalent 'Second Law' should follow a simple path, where we have to concentrate on just one quantity or variable.

What is the difference between unanimated and animated matter? It is the ability to reproduce, to pass on patterns, codes, information. The latter is the term that we should focus on.

Information

Information theory was started by Shannon. This term plays an important role in the question of an origin of life from outside the system (universe). Evolutionists postulate that the information is generated by the arrangement of material elements, like the chemical constituents of the genes - the bases of the DNA. Mutations - new arrangements of the bases would automatically have a new meaning. On the other hand we know from experience that mutations are almost always lethal - the new arrangements mean nothing - information is lost. People with computers at home may refer with amusement to the following 'empirical' statement.

the information you have is not the information you want the information you want is not the information you need the information you need is in the data file @!?&*./#\$, but the data file @!?&*./#\$ **is deleted**.

Information is coded, imprinted on a material carrier. A code is a pattern (eg. energy levels = intensities, colors, shapes, letters, in general ordered structures). A puzzle is a good example. The color and the shape is imprinted on the pieces. there is normally only one way to arrange the pieces to get the full and correct picture. The same is true in languages: If we take 3 letters and permutate them we get 6 combinations (n!=1x2x3x4x...n for n letters).

est ets set tes ste tse

Out of the 6 possibilities only one carries a meaning (information). Why don't the other ones have any meaning? It was determined from outside if the combinations mean something and what they mean. (The decision was probably made at the foot of the tower of Babel.)

Another example is math: It is impossible to find out from which point the mathematical operation started by just looking at the result:

0 + 3 = 3, 1 + 2 = 3, 5 - 2 = 3, 12 / 4 = 3 etc.

The origin of information - in our case for life - must be outside of the system and not within, because the amount of information decreases and never increases. Creation allows for an outside source of information, evolution not. Who or what brought the information into being? Brought into being or existence means created.

Corresponding Terms

Now to the application of the interpretation of the Laws of Thermodynamics for complex systems bearing in mind the analogies from above:

Complex systems are described best by order, information and again the mysterious term entropy which is needed for the time arrow. A table will show the corresponding terms:

machine, process	complex, living system, 'kind' (biblical term) = fly, horse etc.
periodically working	reproducing
heat reservoir	information reservoir (gene pool)

perform, producecreateenergy, heat, workordertemperatureinformation, complexityentropyentropycoolinformation loss

This table may not be clear at first glance. Some comments are in order. It is obvious that a machine and a living system correspond to each other since they are the entities that have content and borders. A periodically working machine returns after a cycle to the same position or state (a piston in the engine of a car, the pendulum, the earth revolving around the sun). A living system itself cannot do that, it repeats itself by reproduction (progeneration). Energy is a quantitative term (an extensive variable, proportional to the amount of mass) - contained in a reservoir of any size. The same applies to order, a term that is linked with structures/patterns. Patterns also have various extensions. Energy can be at different temperature levels. Temperature, although measured and scaled with numbers, is a more qualitative term (intensive variable, independent of the mass under consideration). The higher the temperature at which the energy is encountered or stored the more useful it is. The analogue conclusion for a living system is order and information. The more complex the order, the pattern, the more information can be stored.

These considerations and parallels lead to a formulation of the perpetual motion for living systems that demonstrates the inability of living systems to be involved in an uphill (evolutionary) development:

Perpetual motion of the first kind:

There does not exist a living system that creates order without order being transfered to the system.

This means that the order - a specific arrangement of elements = a pattern - cannot be extended without interference from outside. Someone needs to arrange the elements and keep them in place. By arbitrary motion of the elements patterns are destroyed.

Perpetual motion of the second kind:

There does not exist a reproducing system that creates order by losing information from a reservoir.

Going along with the interpretation of the perpetual motion of the second kind one can explain the formulation that order can only be generated (=work performed) by drawing information from a reservoir (from outside). The order set up in such a way cannot contain the same amount of information because information gets lost just as there are heat losses in the simple machine.

Evolution postulates that the system of the universe is closed and that the necessary information for its development is already inside the system. Matter, according to their mind has the ability for selforganization. Still the question how this ability arises of how the selforganization starts is left unanswered.

Summary:

The First and Second Law of Thermodynamics have been stated for living systems. The formulation was made by replacing corresponding terms. These terms carry analogous or similar meaning an simple respectively in complex systems. By this logic one must conclude that the uphill development postulated by evolution is in principle impossible.