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A NOTE ABOUT THE NEGENTROPY PRINCIPLE

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The function of the Maxwell's demon is analysed in a full thermodynamical cycle. The relation between demon's information and the entropy is a two valued function and thus the Brillouin's negentropy principle is invalid.

The Bolzmann and Shannon entropies H have an identical mathematical form what allowed the negentropy principle to be formulated.

According to this principle, the information should be complementary to the thermodynamical entropy. This idea insists on an analysis of the Maxwell's demon.

Maxwell imagined a minuscule demon posted near a microscopic swinging door in a wall separaring two gases A and B of equal temperature. The demon is instructed to open and close the door so as to allow only the swifter molecules to pass from A to B and only the slower ones to pass from B to A. Clearly the demon can in this way make the gas in B hotter than in A. This means that it can unbind bound energy and hence defeat the Entropy law of statistical thermodynamics /1/.

The Maxwell's demon has been discussed by all generations of physicists. They were interested in two problems: if the demon does work and if he consumes work. Szilard had idea that an entropy gain is connected with a loss of information, Wiener supported it and Brillouin studied conditions on which the demon could perceive molecules. He conclued that the demon must see them and light them actively for this purpose. The demon invests a negative entropy to obtain an information which is changed into the negentropy again. This cycle should be one of proofs of the Brillouin's negentropy theory of information /2/.

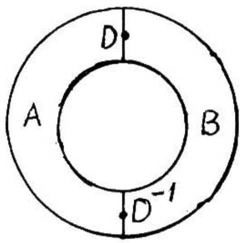
It has been shown recently /3/ that the statistical entropy H is the logarithmic measure of symmetry of natural vector strings in multidimensional Euclidean vector spaces. Bolzmann's and Shannon's definitions of entropy functions are distinct and they are additive, contrary to the negentropy principle. To disprove this principle finally, it is necessary to return to the demon again and to check

Brillouin's arguments.

Till now the discussion concerned only one part of a full thermodynamical cycle. We reformulate the Maxwell's problem. Let us suppose that part A of the vessel contains at the start hotter gas A and part B cooler gas B. (Or, to make the example more realistic, gas A is lighter than gas B and thus its molecules are faster than molecules B at the same temperature.)

The demon, exactly according the Maxwell's instructions, lets go swifter molecules from A to B and slower ones from B to A, till all faster molecules will be in part B and all slower ones in part A. At the beginning it accelerates the spontaneous process then it acts against a spontaneous tendency.

Thermodynamicaly the starting and final states are identical. It is without any effect on the entropy if the hotter gas is on the left or on the right. To show it we can arrange the vessel as a thoroide with a second gate and place in an antipodal demon D^{-1}, /Fig. 1/ acting against the demon D, returning both gases into their original position, allowing the swifter molecules to pass from B to A and only the slower ones to pass from A to B. If we follow the entropy of the system it grows at first till both parts have equal compositions and then it decreases to the starting value.



Or, if both demons D and D^{-1} act simultaneously, they bring the system to an equilibrium.

It is only the second part of the cycle which has been discussed till now. It is worth to remark that the demon proceeds equally in both parts of the cycle and the both parts must explained consistently.

There are two possibilities. If we accept the Maxwell's premise that the demon diferentiates the temperature without work, then he can not gain it during the first part of the cycle which goes on spontaneously. If we suppose that he does work during the second part of the cycle, he can gain it at first. This are two distinct thermodynamical pathes and their choice is irrevelant for our discussion.

For our argument it is important that the demon works in both halves of the cycle identically, its gain of information is equal but the effect of its information on the entropy depends on the state of the system. At first it mixes molecules and so it increases the entropy, then it sorts molecules and decreases the entropy. It is clear that the relation between demon's information and the entropy is a two-valued function. This fact has been omitted by Brillouin and thus his analysis of demon's work has not been, at least, complete.

The negentropy theory of information is based on dubious premises and it is not necessary to take it seriously. The negentropy principle can be exorcised as a ghost from the science.

References

1. N. Georgescu-Roegen, The Entropy Law and the Economic Process. Cambridge, Harward University Press, 1971

2. L. Brilouin, Science and Information Theory, New York, Academic Press 1956

3. M. Kunz, Information Processing and Management, 20, 519 (1984)

parts must be explained consistently.

There are two possibilities. If we accept the Maxwell´s premise that the demon differentiates the temperature without work, then it can not gain it during the first part of the cycle which goes on spontaneously. If we suppose that it does work during the second part of the cycle, it can gain it at first to keep the cycle reversible.

If we deny, in accord with Brillouin, the demon its supernatural capabilities, then the system is not isolated, because the demon adds into energy which changes the basic cycle. But this is insignificant for our discussion.

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The same fault can be found on the recent attempt to connect the entropy decrease with the memory of the demon. It needs to forget its information about preceeding states of the system /4/. But it must forget even if it tries to regulate the spontaneously going process connected with the entropy increase.

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References

1. N. Georgescu-Roegen, The Entropy Law and the Economic Process. Cambridge, Harward University Press, 1971
2. L. Brilouin, Science and Information Theory, New York, Academic Press 1956
3. M. Kunz, Information Processing and Management, 20, 519 (1984)
4. C.H. Bennet, Scientific American, 257 (5) 52 (1987)