# USING THE SECOND LAW MORE EFFECTIVELY

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*Creationists could make more effective use of the second law of thermodynamics by pointing out three facts: (a) The second law applies as rigorously to open systems as it does to closed ones. (b) Solar energy increases entropy on the earth, which is not what evolutionists want. (c) There are no known exceptions to the law, not even in living systems.*

In debates with creationists, evolutionists often claim that:

1. The second law of thermodynamics does not apply to open systems.
2. Energy from the sun produces evolution on the earth.
3. Some systems, particularly living organisms, violate the second law.

Although creationists have made many good points in refuting such claims, it seems to me that they could be more positive in doing so. Let us examine each claim in order.

## 1. Open Systems

Although textbooks often state the second law in terms of a closed system, it is possible to formulate the law in terms of an open system. One can start with a closed-system formulation of the law and derive, with mathematical rigor, an open-system formulation such as the following:

$$dS = dS_{ext} + dS_{int} \tag{1}$$

$$dS_{int} \geq 0 \tag{2}$$

In this formulation, given by evolutionist physicists,[1] $dS$ is the change of entropy in an open system during a time interval $dt$, $dS_{ext}$ is the amount of entropy flowing into (or out of) the system from the exernal surroundings, and $dS_{int}$ is "the [internal] entropy production due to irreversible processes inside the system such as diffusion, chemical reactions, heat conduction, and so on."[1] What these equations say is that even in an open system, there is an internally-produced part of the change in entropy which is never negative.

In other words, the only way to decrease entropy in any system is to have a flow of entropy out of the system which is greater than the sum of the entropy flowing into it and the internally-produced entropy. Such an entropy outflow is equivalent to putting information and order into the system from outside it. But as long as entropy inflows and outflows are accounted for, the second law holds.

So the second law *does* apply to open systems. A simple affirmation of this fact, along with an appropriate reference, could settle much of the dust raised by the "open systems" claim.

## 2. Energy from the Sun

By definition, the change in entropy of a system at temperature $T$ degrees Kelvin when the system receives a small quantity of heat $dQ$ is:[2,3]

$$dS = \frac{dQ}{T} \tag{3}$$

In this definition of entropy, a positive value for $dQ$ means that the system is receiving energy.[3] Since the absolute temperature $T$ is always positive, a positive value for $dQ$ results in a positive value for $dS$. In other words, a net *inflow* of energy into a system will *increase* its entropy. A simple example is a pot of water on a stove. An inflow of heat into the water increases the disorder among the water molecules and so increases the entropy of the water.

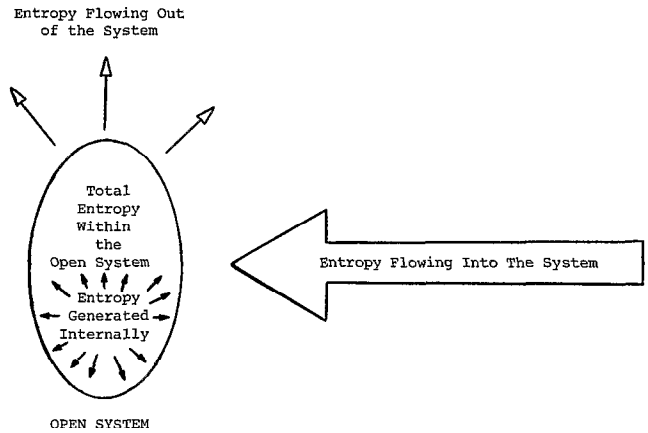


**Figure 1. Entropies to be accounted for in an open system.**

Now let us consider the earth and its atmosphere as an open system which is receiving energy from the sun. Since energy is flowing *into* the system, equation (3) says there is a positive entropy flow also going into the system. If we use the known energy flux from the sun, we can estimate the rate of entropy increase on the earth due to incoming solar energy alone. The result turns out to be about 140 trillion calories per degree Kelvin per second.[4] This is a large flow of entropy—but it is in the wrong direction to produce evolution. Evolutionists want the sun's energy to produce greater and greater order upon the earth; this requires that entropy be decreasing in our open system. But solar energy does just the opposite; it *increases* the earth's entropy!

Of course, the earth reflects or re-radiates much (but not all) of the incoming solar energy back into space, so the net increase of entropy may not be as great as mentioned above. But the main point is that the incoming solar energy produces an effect opposite to the one desired by evolutionists. In all the debates and articles, I have never seen any creationist point out this simple fact in response to the "energy from the sun" claim. Yet it seems to me to be a very effective point to make.

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### 3. Systems Violating the Second Law

Occasionally creationists make statements which allow room for exceptions to the second law, such as: "Now, if one examines closely all such systems to see what it is that enables them to supersede the Second Law locally and temporarily . . ."[5] But there is no evidence that even temporary or local violations of the law exist. A well-known physicist wrote, concerning exceptions to the second law: "In fact, no violation can be brought about in this case, nor with any of the ingenious and often subtle engines which have been devised with the object of circumventing the law. Moreover, the consequences of the law are so unfailingly verified by experiment that it has come to be regarded as among the most firmly established of all the laws of nature."[6]

In view of the strength of this statement (and many others like it), it would seem that the burden of proof for exceptions to the second law should lie heavily upon the evolutionist. In an excellent article,[7] Dr. Emmett L. Williams showed that though biological systems are so complex that they have not yet been rigorously analyzed, there is much evidence that the second law does apply to living organisms, and no evidence that it does not. "There is simply not enough scientific information available to substantiate the claim that living systems violate the second law of thermodynamics."[8]

Therefore, since there is such strong experimental evidence that the second law applies to all systems, open or closed, living or non-living, creationists do not need to grant to evolutionists the ground of possible exceptions to the second law of thermodynamics.

### References

[1]Prigogine, I., G. Nicolis, and A. Babloyantz, 1972. Thermodynamics of evolution, part one, *Physics Today*, November, p. 24.
[2]Pippard, A. B. 1957. The elements of classical thermodynamics. Cambridge University Press, London, pp. 36, 37.
[3]Zemansky, M. W. 1957. Heat and thermodynamics. Fourth Edition. McGraw-Hill Book Co.. Inc., New York, pp. 176, 177.
[4]The energy flux from the sun is about 2 calories per minute per square centimeter (Handbook of Chemistry and Physics. 1970, 51st edition, Chemical Rubber Company, Inc., p. F-151, under "solar constant"), or about 0.033 cal/sec-cm². The area the earth presents to sunlight is about $1.27 \times 10^{18}$ square centimeters, so the earth is receiving a total of about $4.2 \times 10^{16}$ calories per second from the sun. Dividing this energy flow by the approximate average temperature of the earth's surface and atmosphere, 300 °K, gives us an entropy flow of $1\text{-}4 \times 10^{14}$ calories per °K per second.
[5]Morris, H. M., editor, 1974. Scientific creationism. Creation-Life Publishers, San Diego, p. 43.
[6]Pippard, A. B. *Op. cit.*, p. 30.
[7]Williams, E. L. 1971. Resistance of living organisms to the second law of thermodynamics, *Creation Research Society Quarterly*, 8 (2):117-128.
[8]*Ibid.*, p. 125.

# A NEW THEORY OF THE ELECTRON

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*In this article work begun in a previous one, Reference 20, is continued. Two matters especially are considered. One is the increase of mass of charged elementary particles moving at high speeds. Special relativity includes this increase, but offers no physical explanation; it is hard to see how arguments about observers can explain what happens when no observers are present. Here the increase of inertia is seen to be due to the magnetic field generated by the motion. The other matter is the stability of elementary particles such as electrons. These particles are basic to electrodynamics; but electrodynamics predicts that the particles would explode, unless there be additional forces to bind them together. Here such a binding force is investigated; and an incidental outcome of the investigation is the removal of a discrepant factor, such as ⅓, which has long plagued theories of the electron.*

### Outline



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## I. Introduction

Since its beginning with Galileo toward the end of the sixteenth century, classical physics has enjoyed many great accomplishments. In 1630, Johannes Kepler provided a foundation for astrophysics when he was able to formulate his three laws of planetary motion