Mon May 06 12:02:08 1996:

I'm always on the look out for things that exploit the anomalies of the immutable 'laws' of the Guardians of Status Quo. Sanjan Amin has found a way to exploit Carnot's Cycle, what all thermal engines are based on, in such a way than many new devices can be built. For example a chemical free air conditioning system that uses no freon or other CFC's as just one example... - Bob

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The following information explains the fundamentals of the "Amin Cycle", it comes from pages 67 to 70 (Chapter 5: "Carnot's Cycle on Considering The Gravitational Forces Into Account") of the book "Entropy - The key To Unlimited Resources", ISBN 0-9643037-0-1, by Sanjay Amin, Copyright 1994.

Sadi Carnot:

Carnot's Cycle is the foundation of all devices which deal with heat. It predicts the performance of an ideal device converting heat energy to power or transferring heat energy from a lower temperature to a higher temperature. It is also the foundation of all other Heat Engine and Refrigeration Cycles. It is the foundation of the engine in your car, the jet engine in an airplane, the engine in your lawn mower, the machine in your refrigerator and air conditioner and also of the power plants which drive the generators which produce electricity for your home. Any machine which deals with the conversion of heat has to deal with the Carnot's cycle.

The Carnot's Cycle is named after its originator, "Sadi Carnot", who was a French engineer and physicist. In 1824 he examined the basic problems of the operation of the steam engine: the amount of heat supplied as compared with the work produced, the maximum amount of work that can be produced, the suitability of water as the best medium of power. He identified the ideal conditions in which mechanical energy is produced from heat in a steam engine and in heat engines in general. In spite of his intentions, Carnot's work had no practical effect on the design of engines, but its greatest impact was on pure science, particularly on the studies of the thermal properties of matter.

Sadi Carnot was born in Paris on June 01, 1796 and was named after a medieval Persian poet and philosopher. Sa'di of Shiraz. The writings of Shiraz were in vogue in Paris and Sadi's father was a member of the five-man Directory that governed France between the Revolution and the rise of Napoleon. In this period of unrest, the family suffered many changes of fortune. His father fled into exile a few months after Sadi's birth and three years later he returned and was appointed as Napoleon's minister of war, but was soon forced to retire. A writer on mathematics and mechanics as well as military and political matters, the elder Carnot now had the leisure to direct his son's early education.

Sadi entered the Ecole Polytechnique in 1812, which was considered as an institution providing a fine education and which had a faculty of famous scientists aware of the latest developments in physics and chemistry, which they based on a rigorous mathematics. Napoleon's empire was being rolled back and European armies were invading France. And soon Paris was besieged, and the students, Sadi among them, fought a skirmish on the outskirts of the city.

Sadi remained an army officer most of his life. Friends described him as reserved, almost taciturn, but insatiably curious about music, science and technical progress. The mature creative period of his life began when Sadi transferred to the recently formed General Staff in 1819, and quickly retired on half pay, living in Paris on call for army duty. Sadi attended public lectures on physics and chemistry provided for workingmen. He was also inspired by long discussions with the prominent physicist and successful industrialist Nicolas Clement-Sesormes, whose theories he further clarified by his insight and ability to generalize.

Sadi was always occupied with the problem on how to design good steam engines. Steam power already had many uses then but was very inefficient. The imports of advanced British steam engines into France after the war with Britain showed Sadi how far French design had fallen behind. It irked him greatly that British had progressed so far trough the genius of a few engineers who lacked formal scientific education. British engineers had also accumulated and published reliable data about the efficiency of many types of engines under actual running conditions; and they vigorously argued the merits of low and high pressure engines, and of single-cylinder and multi-cylinder engines.

The working steam engine was constructed about 1712 by Thomas Newcomen, a British blacksmith. Very rapidly the Newcomen engine was installed as a power source for water pumps in coal mines throughout Britain. It replaced cumbersome and costly horse-team-powered pumps.

The early ideas regarding the essentials of the steam engine were very crude by today's standards. Although it is called a steam engine the fuel being burned under the boiler actually provides the power for the engine. Early experiments were not entirely convinced of this, however. The power source for the steam engine was considered to be steam and the efficiency of the engine was measured in terms of the amount of steam it consumed. Many of these early ideas did improve the steam engine considerably, especially those of the Scottish inventor James Watt, who patented the first really efficient steam engine in 1769. Watts engine was so efficient that he was able to give it away rather than sell it directly. All the users of the engines had to pay Watt was the money saved on fuel costs for the first three years of operation of the engine. Watt and his partner Matthew Boulton became wealthy, and the Industrial Revolution in England received a tremendous boost from a new source of cheap power.

Convinced that France's inadequate development of the steam engine technology was a factor in its downfall, Sadi began to write a nontechnical work on the efficiency of steam engines. In his book, Reflections on the Motive Power of Fire, published in 1824, Carnot tackled the essence of the process of heat engines, not concerning himself as others had done with its mechanical details.

He saw that, in a steam engine, motive power is produced when heat drops from a higher temperature of the boiler to the lower temperature of th e condenser, just like water when falling provides power in a water-wheel. He worked within the framework of the caloric theory of heat, assuming that heat was a gas which could be neither created nor destroyed. Though the assumption was incorrect and Carnot himself had doubts about it even while he was writing many of his results were nevertheless true, notable the prediction that the efficiency of an idealized engine depends only on the temperature of its hottest and coldest parts and not on the substance (steam or any other fluid) which drives the mechanism.

Although formally presented to the Academy of Sciences and given an excellent review in the press, the work was completely ignored until 1834, when Emile Clapeyron a railroad engineer, quoted and extended Carnot's results. Several factors might account for this: the number of copies printed was limited and the dissemination of scientific literature was slower, and such a work was hardly expected to come from France, which was considered very backwards in steam technology. Eventually Carnot's views were incorporated by the thermodynamic theory as it was developed by Rudolf Clausin in Germany (1850) and William Thomson (later Lord Kelvin) in Britain (1851).

When Carnot formulated his theory gravity was totally ignored as the technology then was so underdeveloped that it is hard to imagine if anyone would even think that gravity can have any subsequent impact on the processes of the steam engine. And gravity is the leading lady of the Amin Cycle.

Amin Cycle:

Let us analyze the Carnot's Cycle while considering the effects of gravitational forces on the gas. In classical thermodynamics Carnot's Cycle gives the maximum heat engine efficiency. The Carnot's Cycle consists of two isothermal and two adiabatic processes. A Carnot's Cycle using an ideal gas as a working substance is shown on the Temperature-Entropy diagram in Figure 5-1. It comprises the following steps:

(01) The gas expands isothermally at temperature T2 absorbing heat Qh, (1-2).

(02) The gas expands adiabaticly until its temperature drops to T1, (2-3).

(03) The gas is compressed isothermally at T1, rejecting heat Qc, (3-4).

(04) The gas is compressed adiabaticaly back to its initial state at temperature T2, (4-1).

Thus Qh is equal to the work done by the gas during its isothermal expansion at temperature T2, and considering the gas to be in a gravitation field:

[Note the formals in the book are in standard mathematical representation, which is impossible to duplicate in a ASCII file like this. The (^) symbol represents a SuperScript in the formals below. -Bob]

$$Q_h = ne^{-mgh/kT2} RT_2 \ \mathrm{In}\ V2/V1 \qquad (56)$$

And change in Entropy:

$$S_{Qh} = ne^{-mgh/kT2} R \ \mathrm{In}\ V2/V1 \qquad (57)$$

similarly:

$$Q_c = ne^{-mgh/kT1} RT_1 \ \mathrm{In}\ V4/V3 \qquad (58)$$

$$= -ne^{-mgh/kT1} RT_1 \ \mathrm{In}\ V3/V4$$

This quantity is negative because V4 is less than V3. The ratio's of the two quantities of heat is thus:

$$Q_c/Q_h = (-T_1 e^{-mgh/kT1} \ \mathrm{In}\ V3/V4) / (T_2 -e^{-mgh\backslash kT2} \ \mathrm{In}\ V2/V1) \qquad (59)$$

The equation can be simplified further by the use of the temperature volume relations for an adiabatic process. We find for the two adiabatic processes:

$$T_2 V_2^{c-1} = T_1 V_3^{c-1}$$

and

$$T_2 V_1^{c-1} = T_1 V_4^{c-1}$$

Dividing the first of these equations by the second, we find:

$$V_2^{c-1} / V_1^{c-1} = T_1 V_4^{c-1}$$

and

$$V_2 / V_1 = V_3 / V_4$$

Thus the two logarithms in equation (59) are equal and the equation reduces to:

$$Qc/Qh = (-T_1 e^{-mgh/kT1}) / (T_2 e^{mgh/kT2}) \qquad (60)$$

The efficiency of th engine is the net work divided by the heat input and

$$E = W/Q = 1 - T_1 / T_2 e^{-mh/k} (g/T1 - g/T2) \qquad (61)$$

This simple results says that the efficiency of the Carnot's engine depends not only on the temperature difference by also on the gravitational force acting on the gas, and the Temperature-Entropy diagram would be as shown in Figure 5-1.

The shaded area shows the decrease in entropy which is given by the equation:

$$(1 - e^{-mh/k} (g/T1 - g/T2)$$

[The closing ")" is missing in the book - Bob]

The above Cycle is a more universal cycle as it takes the gravitational forces into consideration and we shall hereafter call the universal cycle the Amin Cycle.

The conventional Carnot's Cycle is a limiting case of the Amin Cycle as when the value of g is equal to zero, "e^-0", is equal to one and the efficiency of the Cycle is:

$$E = 1 - T1 / T2 \qquad (62)$$

Expression (62) is the efficiency given by the Carnot's Cycle. In Science old theories are never made obsolete by new theories, they just become subsets of the new theories which are more general and encompass more parameters in their formulation than the theories which become their subsets.

For example Einstein's theories are more general in applications and they make Newton's theories a subset.; When some of the parameters in Einstein's equations are reduced, Einstein's equations also reduce to Newtonian equations. That is the beauty of Science, it always looks forward acquiring ever more knowledge and understanding of the universe we live in.

[This is my best shot at figure 5-1 in ASCII not as good as I would like it to be. - Bob]

```
 /|\     /|\      1'          1                                 2
  |    T2 |-------_____________________________________________
  |       |       \  S        |                                |
  e       |        \  H       |                                |
  r       |         \  A      |                                |
  u       |          \  D     |                                |
  t       |           \  E    |                                |
  a       |            \      |                                |
  r       |             \  I  |                                |
  e       |              \  N |                                |
  p       |               \   |                                |
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```
        m       |                \  |                                |
        e       |                 \ |                                |
        T    T1 |------------------\|________________________________|
                |                   4                                 3
                |
            /---*--------------------------------------------------------
            \   |             Phi -------- Entropy ------>
               \|/
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FIGURE 5-1. Temperature-Entropy diagram of the Amin Cycle and the Carnot's Cycle. (1' - 2 - 3 - 4 is the Amin Cycle) (1 - 2 - 3 -4 is the Carnot's Cycle).

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