ANENTROPIC THERMODYNAMICS
Confronting the Second Law

Of the numerous historical challenges to the Second Law of Thermodynamics, the attempt by one Leo Szilard –Hungarian-born physicist generally credited with the discovery of the nuclear chain-reaction— merits closer attention. (More recent examples may be found in ref. [1-3]

The idealized Szilard Engine consists of a cylinder which contains a single gas molecule separated from a frictionless piston by a sliding partition. When the partition is slipped aside, the molecule drives the piston, and then the recoiling particle is re-captured by slipping the partition closed after its return to its original vicinity of the cylinder. The piston is then effortlessly reset, and the process is repeated indefinitely, converting molecular thermal energy into mechanical work. The device would indeed demonstrate an entropy-reversing (or "anentropic") process –were it not for its one subtle flaw: Although no work is done directly *on* the system to reset the cycle, there is nevertheless a net cost in *information consumption*, external to the device itself. Since it can be reset only through intelligent intervention –an expense to the total orderliness of the extended system—the overall entropy does *not* decrease, and the second law holds.

However, this subtle defect may be overcome by a somewhat different engine design:
Given an ideal adiabatically sealed cylinder, divided by a frictionless two-way piston, let a handful of gas molecules be introduced into each of the two compartments on either side of the central piston. If the initial temperature and pressure is the same inside each compartment, nothing happens.
That is, *almost* nothing happens. In fact, since such thermodynamic quantities are ultimately statistical in nature, only the *average* temperatures and pressures are the same. At any given instant, the actual pressure on one side of the piston (the number of molecular impacts per nanosecond) would seldom be *exactly* equal to that on the other side. Hence the piston would tend to oscillate ever so slightly.
This random activity may now be directed to useful work by the insertion of a simple (and very delicate) ratchet mechanism on one side of the piston. This modification would allow for motion of the piston exclusively to the right, for example, while arresting its return to the left, by the shifting impact magnitudes of the respective gas communities. The resulting gradual compression on the right side (with its rise in temperature), and rarefaction on the left side (with its drop in temperature) would work to effect a virtual heat flow reversal. After a time, a ratchet release is tripped, and the piston, entrained with flywheel, pully, or dynamo etc., actually performs mechanical work as it drives back to its initial position. If the process were repeated indefinitely, (ratchet automatically re-engaging), all the thermal energy of the gas would be converted to work, and the interior of the cylinder would approach absolute zero!

Thus the Second Law of Thermodynamics may be at least *theoretically* overcome, without recourse to further information input.

<u>References</u>

1) Science News, 10/7/2000, p. 234
2) Science News, 7/27/2002, p.51
3) Science News, 11/2/2002, p. 286