In press, Ludis Vitalis

Darwin and some leading ideas of contemporary Western culture.

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Two of the leading ideas of contemporary Western culture had been formulated by the end of the Nineteenth Century, by Smith / Malthus / Darwin, and by Carnot / Clausius / Boltzmann. These ideas -- concerning competition and striving -- work together to form the ideological basis of contemporary global capitalism. Both ideas had their origins in the economic context of industrialization.

One thread is:

(a) Adam Smith saw competition as working to improve the quality of economic production, and felt that it needed to be encouraged rather than stifled. The argument has usually been interpreted as being pitched against regulation of an economy.

(b) Malthus' political economy argued that populations tend to outgrow their resources; when that happens not all individuals in a population can survive the resulting turbulence.

(c) Darwin -- assuming that natural populations are generally at the limits of their carrying capacities -- concluded that, if there are different kinds of individuals in a population, then some kinds might survive and reproduce better than others (Spencer's "survival of the fittest"). As a result, this formal competition between kinds would tend to result in organismic improvements by way of a gradual replacement of the less effective kinds over the generations.

The other thread is:

(a) Carnot was concerned with the energy efficiency of heat engines. As the work rate increases (i.e., by the application of more energy) beyond the point where it associates with maximum power, or, in an engine, when it is run faster, or slower, than its most efficient set point, the energy efficiency declines, with a greater portion of the dissipated energy source then being lost as heat energy.

(b) Clausius stated the entropy principle, that, while energy is not lost, it tends to get transformed irreversibly into a useless form -- heat energy -- which he called 'entropy'.

(c) Boltzmann modeled the loss of usable energy statistically as the dissipation of orderly energy gradients into more probable, scattered configurations, dissipating the potential energy. Thus an energy gradient is taken to be an improbable form and, as such, could not survive the spontaneous tendency to dissipate by way of scattering. And so dissipation by way of entropy production is taken to be the inevitable fate of any energy gradient – that is, of any material thing at all.

Putting these thermodynamic perspectives together, we get: energy gradients tend spontaneously to dissipate; harnessing them to work efforts hastens the dissipation of much of those that can be so utilized, leaving only a small amount embodied in the results of the work.

Connecting Darwin to Carnot et al: reproduction is biological work. The type of organism in a population that reproduces more rapidly than other types is dissipating the energies available to that population more rapidly than are other kinds in the population. As formulated by Fisher: other things being equal, the fastest reproducing types are taken to be the best adapted as demonstrated by this very reproductive rate, and are therefore supposed to embody improvements of some kind over more slowly reproducing types. Thus, improvements made in a population would generally be mediated by way of increased entropy production from the population. And so, in the situation of limited resources that is assumed in the Darwinian perspective, we see that competition for resources within a population leads to striving, which increases entropy production.

These ideas have recently come together under the 'maximum entropy production principle', which can be stated as:

'Systems that can assume several conformations, will tend to assume one, or to return frequently to one, that mediates the fastest entropy production from local energy gradients, consistent with the system's continued survival'.

Annila's perspective, following Swenson, is that energy gradients will get dissipated by the quickest routes available, and that this is a form of natural selection -- among dissipative pathways. This follows from the Gibbs view that decline in available energy gradient is the logical obverse of the production of entropy. The use of energy gradient for work exploits some of a dissipating gradient (the exergy) to power that work, thereby delaying its dissipation to heat energy. However, the greater portion of a gradient supporting effective work is dissipated as heat energy, and faster work increases that wasted portion even as it accomplishes the work faster.

Cosmologically, the Second Law of thermodynamics can be seen to be a consequence of the Big Bang inasmuch as that would necessarily have created a far from equilibrium universe. Assuming that the universe is an isolated system, this disequilibrium would have resulted in eliciting the Second Law. Whatever the source of the far-from-equilibrium condition of the universe, it is demonstrably the case in our section of it, as is the generically poor energy efficiency of any work.

From this perspective, given a choice, faster work can be seen as being entrained by the Second Law as a way of furthering universal thermodynamic equilibration. Thus, the neoDarwinian theory of biological evolution in effect pictures the evolutionary improvements of organisms as being tied to rapid energy dissipation, as entrained ultimately by the far-from-equilibrium condition of the universe.

Connections back to capitalism flow from the fact that, in a nonequilibrium universe, competition between firms will require the fastest work to mediate product improvements, even though this generally entails the most energy wasteful procedures. Energy conservation was dismissed by Jevons early in the rise of capitalism by noting that any savings that might be contrived by efficiency increases would get used elsewhere in an expanding economy. We may note here as well that some energy gradients, like the fossil fuels, would dissipate only very slowly, by mass wasting, if they were not tapped for work.

Another related connection to capitalism is the latter's rejection of any planned economy. This ties into the Darwinian canon by way of the characteristic constraint of neoDarwinism on the origin of new forms, restricting it conceptually to being the result of random mutations (random with respect to the needs of the organisms), this connecting as well as to Monod's 'tinkering' notion as the source of new forms. Linked to this conceptual environment, we have as well Simon's Nobel Prize winning economic concept of 'satisficing' (If it isn't broken, don't fix it.). That is, planning gives no better result than reacting sequentially to challenges as they occur. Van Valen explicitly imprinted this into Darwinism with his "Red Queen's hypothesis" – a population needs to work as hard as it can just to remain extant.

It has been noted that the energy efficiency of machines can be improved by design. As well, it has sometimes been implied that evolution has increased the energy efficiency of organisms. If engines were always run only at their most efficient set point, and if organisms could always act at will in restful conditions, these might be interesting facts. However, both systems are frequently striving and being pushed to their limit. Competition for share of the gene pool drives organisms to strive reproductively just as competition for market share drives economic work rates. Here we might note Bertrand Russell's quip: "Every living thing is a sort of imperialist, seeking to transform as much as possible of its environment into itself and its seed... We may regard the whole of evolution as flowing from this "chemical imperialism" of living matter.".

Bejan has claimed that organism design has evolved to increase access to internal energy gradients by way of decreasing frictional impediments to energy flows. Given the almost continual need for striving, the effect of this is to foster the rate of utilization of energy gradient, thus supporting the maximum entropy production principle. Here the stand-in for entropy production is energy gradient dissipation, which ultimately must lead to the production of heat energy.

I conclude with thoughts concerning why one might be concerned today about these relations. Darwin's natural selection idea can be summed up as -- 'whatever succeeds is good', 'success is its own reward' – success here meaning short-term success[1]. As such, it is hardly a 'theory'! -- except when it gets detailed by the neoDarwinians into a principle that competition is the source of success. Evolutionary psychologists point out that cooperation has evolved in many species, but that is because it succeeds -- *against* non-cooperators in the same species. Importantly, this is not only a leading idea / belief of our culture, but when read into biological evolution -- the process which produced us -- it becomes a mythological theme. The current relevance of this is that it is our capitalist economy that appears to be destroying our natural environments around the globe, and this economy is based in competition, which becomes idolized by being as well the source of we ourselves, in the neoDarwinian theory of evolution. Here a pragmatic principle tends to become sacralized, and it is in this that Darwin's (as Nietzsche would have said, 'English shopkeeper') concept can be said to have become dangerous to our continued cultural survival. As well, in its hectic productivity and search for energy, we could fairly interpret our economic system as earnestly pursuing the goal of universal thermodynamic equilibration, despite the fact that that condition would eliminate us all.

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Note: 1: Long term success in the Darwinian perspective can be said to be the maintenance of fairly well adapted organisms from one generation to the next. This can be also be stated as the maintenance of a population in the game of matching the environment (and, of course, producing entropy) for as long as possible. Economically this means staying in business. That is, the long term here is nothing beyond the maintenance of the current situation. Some think that biological evolution follows from this because environments change.

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