The Oil Drum: Canada
DISCUSSIONS ABOUT ENERGY AND OUR FUTURE

Entropy and Empire

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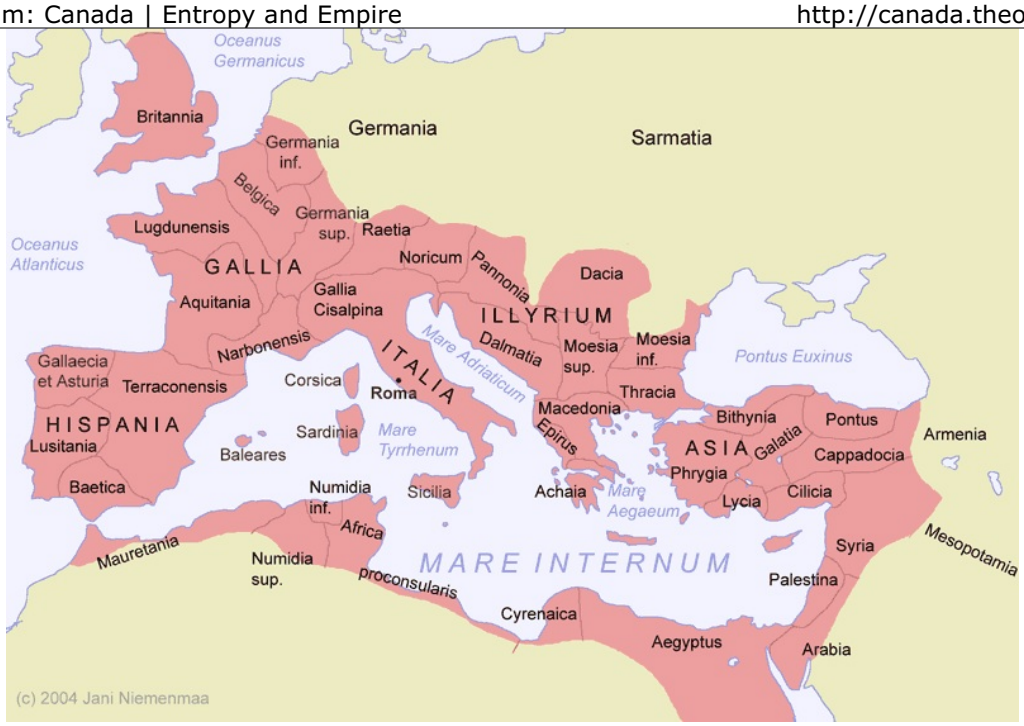
In his recent book *The Upside of Down*, a review of which can be found here, Thomas Homer-Dixon interpreted the development of the Roman Empire in terms of thermodynamics. The success of the empire depended on its ability to extract energy surpluses, in the form of food, from the imperial territories and concentrate them at the centre, where they enabled the development of a tremendous degree of organizational complexity. Without a large, and growing, hinterland to collect surpluses from, complexity on such as scale would not have been possible to establish and maintain.

> But wherever the farms were located, they played a role in the Roman energy economy similar to that of solar battery chargers: they converted sunlight into a form of high-quality potential energy, especially fodder and grain, that was storable and transportable.
>
> The Romans then focused this energy – they used their food batteries, so to speak – to create a productive, resilient, and phenomenally complex system of public buildings, manufacturing facilities, housing, roads, aqueducts, and social organization.

Thermodynamics and the Implications of Entropy

In thermodynamic terms, a highly uneven distribution of energy is an ordered state, and therefore a low entropy condition. Without a continual input of energy from outside the system, entropy within the system would increase, meaning that the relative concentrations would tend to equalize over time. Moreover, if the concentration eventually equalized, it would do so at a very low level. For instance, an even distribution of energy across the universe, which would theoretically occur eventually if the universe were to expand forever, would be called heat death – ironic, as it would be scarcely above absolute zero.

In order to generate a low entropy (ordered) state from a higher entropy (less ordered) state, energy external to the system is needed to drive the concentration of energy within the system uphill. However, entropy in the larger system must increase, in accordance with the laws of thermodynamics. If energy is to be concentrated at the centre, it must come at the price of a lower energy level in the periphery, and the energy loss in the periphery must be greater than the gain at the centre.



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A discussion of the thermodynamics of empire is not complete without discussing the implications of entropy. Many have argued that if only there were fewer people, so that we were living within the natural carrying capacity of the Earth, then all would be able to live at a modern standard of living. However, a modern standard of living requires a very high concentration of wealth – wealth being a proxy for energy, as wealth represents a valid claim on available energy and resources. For enough relative wealth to accumulate in a political centre for a complex civilization to develop, there must be a much larger periphery available to be relatively impoverished in providing the necessary energy subsidy. An equal distribution would, in accordance thermodynamics, only be possible at a low level for all.

The Centre and the Periphery - Then and Now

With solar energy as their external energy source, Rome was able to subjugate a larger and larger expanse of the surrounding territory. It derived a progressively greater total energy subsidy with each conquest, at least until it reached the point where the energy necessary to perform distant conquests became too large in relation to the energy subsidy Rome could hope to gain for itself in the process – a net energy limit. Essentially, Rome managed to establish a long-lasting 'wealth conveyor' in its favour, through the imposition of imperial social, economic and legal structures on the territories of the periphery.

> Beginning in the third century BCE, Roman expansion transformed the capital of other societies into resources for Rome as country after country was conquered and stripped of movable wealth. (from *How Civilizations Fall: A Theory of Catabolic Collapse*, by John Michael Greer)

> Codified laws regulated everything from money and debt to property rights, corporate organization, guilds and the empolyment of labour and slaves. (from *The Upside of Down*, by Thomas Homer-Dixon)

There are obvious parallels between the Roman situation and our own, both from the point of view of political centres and from the perspective of the hinterland. The solar energy subsidy available to the Romans allowed them to create a concentration of ordered socioeconomic

complexity in a sea of relative disorder and and simplicity, driving entropy in reverse locally. Western industrial economies, and more recently other competing centres of political power in the era of globalization, have been able to do the same, but to a much greater extent due to the very much larger energy subsidy provided by fossil fuels. The centres have seen spectacular gains in complexity, while the hinterland has stagnated, to a greater and greater extent over time.

> Indeed, in any complex society, those of us who aren't farmers are essentially parasites on those of us who grow the sources of energy – the grain, vegetables, fruit and meat – that keep all our bodies running. (from *The Upside of Down*, by Thomas Homer-Dixon)

Although there is currently no center which claims direct political control over a large periphery as Rome did (a *de jure* empire), there is nevertheless at least one *de facto* empire in the form of the industrialized West, and more specifically the United States. The economic power of the US (with its reserve currency advantage) to determine the terms of international finance and trade, backed by its military strength and extensive network of permanent military bases, has resulted in the ability to entice, cajole or coerce a large periphery into accepting life on the terms of the 'imperial' center. This has involved the monetization of peripheral economies, often in tandem with leading those nations into a deep indebtedness thereafter managed through structural adjustment programs by quasi-imperial institutions such as the IMF. The net effect has been the debt enslavement of whole nations, despite their putative sovereignty, as the established wealth conveyor carries resources and surpluses to the center while leaving most of the externalities behind.

> We are entering a bifurcated world. Part of the world is inhabited by Hegel's and Fukuyama's Last Man, healthy, well fed and pampered by technology. The other, larger, part is inhabited by Hobbes' First Man, condemned to a life that is "poor, nasty, brutish and short". (from *The Coming Anarchy*, by Robert Kaplan)

A political centre gains the ability to create order - a highly differentiated society capable of monumental architecture - at the cost to the periphery of a greater loss of order. The centre gains resources while avoiding many unpleasant externalities, but the periphery must suffer a loss of both resources and surpluses due to labour, and must tolerate all the externalities involved in providing for itself and for the centre. Many parts of third world periphery - stripped of resources and burdened with externalities - now verge on anarchy, as there is too small a concentration of energy left locally to support an ordered state.

> Sierra Leone is a microcosm of what is ocurring, albeit in a more tempered and gradual manner, throughout West Africa and much of the underdeveloped world: the withering away of central governments, the rise of tribal and regional domains, the unchecked spread of disease and the growing pervasiveness of war. (from *The Coming Anarchy*, by Robert Kaplan)

Entropy and the Twilight of Empire

Rome eventually hit a net energy limit and could no longer sustain its internal complexity. Efforts to strengthen the wealth conveyor through repression during the reign of Diocletian - an elaborate, highly intrusive and draconian regime of taxation in kind - amounted to feeding the center by consuming the productive farmland and peasantry of the empire itself. This period represented a brief reprieve for a political center declining in resilience, at the cost of catabolic collapse. Regions incorporated into the empire declined to a lower level of complexity than they had attained before being conquered.

> Thus Britain in the late pre-Roman Iron Age, for example, had achieved a stable and flourishing agricultural society with nascent urban centers and international trade connections, while the same area remained depopulated, impoverished, and politically chaotic for centuries following the collapse of imperial authority. (from *How Civilizations Fall: A Theory of Catabolic Collapse*, by John Michael Greer)

No longer able to project power at a distance, or to defend the concentration of wealth (and therefore energy) which had permitted entropy to be held at bay, the western Roman empire fell. The result was the loss of an ordered state - with sharp disparities in energy concentration and resultant socioeconomic complexity - in favour of a more even distribution of both. When entropy finally gained the upper hand, concentrations of wealth, and the claim to energy represented by wealth, were impossible to sustain. Equalization at a low level was the natural outcome in the area of the former empire, although wealth conveyors in favour of other centers, such as the eastern empire, strengthened in their turn. Rome itself remained a backwater for a thousand years.

The ability to concentrate wealth from the surrounding area arguably proceeds in cycles of ascendancy, supremacy and decline. A new center begins to develop, often by being the beneficiary of wealth diversion from an established center where the citizens would rather buy the labour of others with their accumulated wealth than engage in labour themselves. Services persist in a decadent centre, but real wealth creation is out-sourced, perhaps allowing a new center to reach critical mass - at which point its development would become self-sustaining. For instance, the gold of Spain at the height of its power established industry in Britain, the Netherlands and elsewhere in Europe.

As one Spaniard wrote at the time:

> Let London manufacture those fabrics of hers to her heart's content; Holland her chambrays; Florence her cloth; the Indies their beaver and vicuna; Milan her brocades; Italy and Flanders their linens, so long as our capital can enjoy them. The only thing that it proves is that all nations train journeymen for Madrid and that Madrid is the queen of Parliaments, for all the world serves her and she serves nobody. (quoted in *The Wealth and Poverty of Nations*, by David Landes)

New centres grew in power, while a decadent Spain declined into inward-looking repression as the supply of gold ran out. According to David Landes:

> By the time the great bullion inflow had ended in the mid-seventeenth century, the Spanish crown was deep in debt, with bankruptcies in 1557, 1575 and 1597. The country entered upon a long decline. Reading this story, one might draw a moral: Easy money is bad for you. It represents short-run gain that will be paid for in immediate distortions

> and later regrets. (from *The Wealth and Poverty of Nations*)

With the transfer of wealth, and eventually the power to concentrate wealth from the surrounding area, also comes the transfer of hegemonic power. Britain in turn exported wealth to North America, and in doing so spawned a competitor with the luck to have access to a hitherto unexploited continent. The American Century has been the result.

In recent years, the wealth conveyor in favour of the industrialized West has appeared to be approaching natural limits. In freeing capital to seek a lower cost base through globalization, the West has fed the development of major new competitors in Asia. In addition, the supply of fossil fuels, which have served as the external energy source driving the accumulation of wealth, is arguably approaching a net energy limit. Social order in parts of the periphery is becoming so compromised that further resource extraction may no longer be possible.

> West Africa is reverting to the Africa of the Victorian atlas. It consists now of a series of coastal trading posts, such as Freetown and Conakry, and an interior that, owing to violence, volatility and disease, is again becoming, as Graham Green observed, “blank” and “unexplored”. (from *The Coming Anarchy*, by Robert Kaplan)

If the West follows in the footsteps of Rome before it, one would expect that the loss of the ability to access new energy subsidies, or even maintain current energy flows, would result in the development of the same repressive, catabolic process that temporarily reinvigorated Rome under Diocletian. The implications for surrounding territories could be unpleasant.

Eventually, the ability for the old centre to project power at a distance, or perhaps even to hold together as a nation would be lost, as the mechanism for concentrating wealth at the center would break down. After that, entropy would be expected to run its course, resulting in the relative equalization of wealth, and therefore energy, between the old center and its erstwhile periphery.

The Rise of a New Centre?

The interesting question for the future would be whether the developing competitors - initially fed by exported Western capital but now reaching critical mass as new centres in their own right - would be able to achieve self-sustaining development as capital exports from the old centre cease. If so, the primary wealth conveyor would be re-established in favour of a new centre and, as has happened many times throughout history, hegemonic power would eventually follow.

However, the developing Asian centres are as dependent on energy subsidies in the form of fossil fuels as the current Western centre, and also as vulnerable to the effects of climate change, water scarcity, pollution and financial instability. It is difficult to imagine a smooth transition of political and economic power to a new centre while carrying capacity is arguably shrinking in all regions even as population continues to expand. If a new cycle of ascendancy is to begin elsewhere in due course - catagenesis, to use Homer-Dixon's phrase - it appears unlikely to do so without a considerable increase in entropy in the meantime.

> Sadly, though, history shows that most human civilizations over-extend the growth phase of their adaptive cycle, so they eventually suffer deep collapse. "A long view of human history reveals not regular change but spasmodic, catastrophic disruptions followed by long periods of reinvention and development," writes Holling. (from *The Upside of Down*, by Thomas Homer-Dixon)