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## **The Upside of Down: Catastrophe, Creativity and the Renewal of Civilization**

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Thomas Homer-Dixon has written an interdisciplinary tour-de-force integrating the many challenges facing industrial civilization into an elegant conceptual framework. That framework – catagenesis – applies an understanding of natural cycles of growth, breakdown and renewal to the present and the future of our global society. Our prevailing complacency is based on trust in our science to give us the knowledge, our markets to give us the incentives, our democracy to give us the social resources and our brains to give us the ingenuity necessary to solve our increasingly complex problems. However, that blind trust may be misplaced given the array of tectonic stresses facing our civilization and raising the risk of synchronous failure.



*Thomas Homer-Dixon*

### **The Thermodynamics of Empire**

The thermodynamics of empire is an underlying theme in Homer-Dixon's discourse, particularly in relation to ancient Rome, although parallels are drawn with the present day. Homer-Dixon has a talent for vividly illustrating his descriptions of Rome's dominance and subsequent decline with examples from his own travels and experiences – from calculating the land required to support the building of the colosseum to observing the deteriorating quality of the limestone deposits lining a Roman aqueduct in southern Gaul, to discussing the large error margins built into Roman engineering and their consequences for resilience.

Rome's success 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. However, the EROI of imperial energy tributes declined over time to the point where the complexity of the centre could no longer be maintained without drastic action being taken. That action – an elaborate, highly intrusive and draconian regime of taxation in kind - was taken during the rule of the emperor Diocletian, but its rejuvenation of the empire's fortunes proved to be temporary as stressors continued to build against an empire declining in resilience as it burned through its own capital – productive farmland and peasantry. Eventually, "the empire could no longer afford the problem of its own existence". Homer-Dixon argues that industrial civilization may be approaching the exhaustion of its means of supporting its current level of complexity, and that we too may be faced with making adjustments comparable to those made in the fourth century. However, these measures could represent merely a temporary reprieve unless we conceive of different organizational principles addressing our own stressors.

### **Stressors, Multipliers and Negative Synergy**

Homer-Dixon identifies, and discusses at length, five major tectonic stresses – population growth, energy depletion and declining EROI, environmental degradation, climate change and financial instability. In addition, he discusses the effect of two multipliers – the escalating destructive power of small groups and the rising speed and connectivity of our socioeconomic system – and the potential for negative synergy between them. Our management approach to

dealing with the problems facing us adds additional layers of complexity to what is arguably already a cumbersome, rigid and dysfunctional governance system declining in resilience. Homer-Dixon argues that delusional optimism and passivity should be replaced with a prospective mind prepared to engage aggressively with a world of risk and uncertainty, in other words that passengers should become drivers.

Connectivity and speed are critical attributes of complex systems and consistent themes throughout *The Upside of Down*. Both positive and negative effects are demonstrable, although the positive effects have been given far more attention in the media as they have formed a major justification for globalization.

Together, greater connectivity and speed often make economies and societies more resilient to shock because they can respond faster and draw from their larger networks a wider range of skills, resources, capital and goods and services.

The downside to connectivity and speed - neglected in the popular discourse – is well explored here, where it is a key to understanding the potential for synchronous failure. Homer-Dixon illustrates his point dramatically with a near-miss personal experience of traffic moving at high speed and closely enough together for there to be effective connections between the various elements. Failure of one element in such a tightly coupled system can quickly lead to a cascading failure, such as a major highway accident at speed or cascading financial contagion. Where systems are intimately linked, disturbances can propagate over great distances and have potentially devastating impacts that would not have been possible had the components remained isolated. Connectivity can therefore lead to systems which are less resilient instead of better able to tolerate disturbances. Moreover, tight coupling can lead to unanticipated emergent properties, such as feedback loops, requiring complex new management systems with their own attendant costs.

Negative synergy, which Homer-Dixon discusses with reference to an extremely intense fire near San Bernardino, involves a confluence of factors compounding each other's negative effects. In the case of the fire, people had moved into an edge zone, dead plant material had built up over time as all fires had been suppressed, and a drought had occurred simultaneously with a beetle infestation that had killed many trees. The result was an intense conflagration far larger than would normally be expected – an event much more difficult for an ecosystem to recover from. Homer-Dixon is concerned that we may be facing a confluence of stressors and multipliers capable of triggering a deep collapse event, which we also may have difficulty recovering from.

### **The Nature of Networks**

The nature of networks can have a significant impact on their vulnerability to disruption. Random networks like the US interstate system have loosely connected nodes each with relatively few links, but scale-free networks - the air traffic network, the internet, food distribution systems, electrical grids - have critical hubs linking to many nodes. Damage to an ordinary node usually has little effect, but damage to a hub can cripple a network. Homer-Dixon points out that as scale-free networks develop greater connectivity, new nodes link preferentially to hubs, making them even more dominant and making the network more vulnerable to intentional disruption. Where networks are tightly linked, as in a modern just-in-time economy, failures can jump system boundaries.

### **Tightly Coupled Socioeconomic Systems and Financial Risk**

Homer-Dixon quotes George Soros to say that civilizations fall due to a morbid intensification of their own first principles. In the case of global capitalism, the growth imperative is becoming all-consuming in order to maintain demand as production increases.

Since the 1930s, generations of economic policy makers, especially central bankers, have been acutely aware of the dangers of inadequate demand. The grim lesson of the Great Depression has been seared into their minds: a chronic demand shortfall – and the frightening price deflation that accompanies it – can cripple economies, cause unemployment to skyrocket, and catalyze political extremism.

However, the growth imperative conflicts with the imperative to conserve resources and prevent degradation of the environment. Homer-Dixon argues that economic growth, resource use and environmental damage remain tightly coupled, although economic globalization has helped to conceal the consequences of the growth imperative for rich countries.

The stabilizing negative feedback loops of classical economic theory are, in practice, increasingly giving way to destabilizing positive feedback loops as modern communications technologies have increased the ease and pace of transactions and eliminated distance as a factor. Crises can now spiral out of control before policy makers can respond.

Conventional economic theory suggests that capitalist economies will gravitate toward equilibrium....as changing prices for goods and services balance supply with demand. In actual fact, though, like any complex system a capitalist economy can sometimes exhibit unbalanced and capricious behaviour. Instead of acting like a smoothly functioning and predictable machine... it can act more like the planet's climate with its synergies, feedbacks, multiple equilibriums and threshold effects. This is what happened in East Asia in mid-1997, when a self-reinforcing feedback of investment, profit, consumption and more investment flipped overnight to a vicious circle of falling investment, failing banks and crashing consumer demand.

### **Diminishing Marginal Returns to Complexity**

According to Tainter, whom Homer-Dixon interviewed for *The Upside of Down*, people do not stop choosing to institute complex solutions once they hit diminishing marginal returns to complexity because the problems those solutions are designed to address do not go away. They simply become ever more expensive to solve, until merely maintaining the status quo, amid a series of concatenating problems reinforcing each other in unanticipated ways, consumes a greater and greater percentage of a society's resources. Complex solutions are chosen for their short-term effects without consideration of the longer-term consequences, even when the long-term costs of entrenched solutions can be very high. As more wealth is devoted to old problems, little is left to address new ones, which can lead to generalized dissatisfaction and a loss of legitimacy for the organizing principles of society.

### **Panarchy**

Homer-Dixon's catagenesis – collapse and renewal – builds on the panarchy theory of ecologist Crawford Holling, who was also interviewed extensively for *The Upside of Down*. Panarchy - named after Pan, the Greek god of nature – describes adaptive cycles of growth, collapse, regeneration and growth again observed by Holling in his work on forest ecosystems. During the growth phase natural capital is accumulated and growing connectedness helps to maintain stability.

This growth phase can't go on indefinitely. Holling implies – very much as Tainter argues in his theory – that the forest's ever-greater connectedness and efficiency eventually produce diminishing returns by reducing its capacity to cope with severe outside shocks. Essentially, the ecosystem becomes less resilient. The forest's interdependent trees, worms, beetles and the like become so well adapted to a specific range of circumstances – and so well organized as an efficient and productive system - that when a shock pushes

the forest far outside that range, it can't cope. Also, the forest's high interconnectedness helps any shock travel faster across the ecosystem. And finally, the forest's high efficiency makes it harder for it to realize its rising potential for novelty. For instance, the extra nutrients that the forest system has accumulated aren't easily available to new species and ecosystem processes because they're fully expropriated and controlled by existing plants and animals. Overall, then, the forest ecosystem becomes rigid and brittle. It becomes, as Holling says, "an accident waiting to happen."

The parallels with social systems are obvious. James Kunstler has described efficiency as "the straightest path to hell" precisely because when resources are used as efficiently as possible, there is no spare capacity to absorb shocks to the system.

Somehow we have to find the middle ground between dangerous rigidity and catastrophic collapse. In our organizations, social and political systems, and individual lives, we need to create the possibility for what computer programmers and disaster planners call 'graceful failure'. When a system fails gracefully, damage is limited, and options for recovery are preserved. Also, the part of the system that has been damaged recovers by drawing resources and information from undamaged parts.

According to Holling, adaptive cycles occur at different scales temporally and spatially – from the stream to the forest to the region – and interact each other hierarchically. If cycles at different scales are in different phases, they are able to compensate for each other to some extent and prevent collapse becoming catastrophic. Higher level, slower moving cycles provide stability and resources that can buffer the forest and allow it to recover from collapse more rapidly, while lower level, faster cycles represent a source of novelty and experimentation. The long-term effect of localized collapse – part of the normal process of adaptation and evolution - can be positive as new ecological solutions may evolve and thrive.

Put simply, the catastrophe of collapse allows for the birth of something new. And this cycle of growth, collapse, reorganization, and rebirth allows the forest to adapt over the long term to a constantly changing environment. "The adaptive cycle," Holling writes, "embraces two opposites: growth and stability on one hand, change and variety on the other." It's at once conserving and creative – a characteristic of all highly adaptive systems.

However, where adaptive cycles have become tightly coupled, they can become synchronized – trapped in an extended growth phase together for longer than normal, so that they all peak together and reinforce each other's eventual collapse. Recovery from the resulting deep collapse can take much longer, or may not be possible at all. The concept is reminiscent of Tainter's description of group polities evolving together, which effectively enable each other to grow in synchrony for longer than would normally be possible, then collapse simultaneously. Tainter, in his classic work *The Collapse of Complex Societies*, wrote that the globalized economy of nation states potentially represented just such a system.

### **Catagenesis**

Although acknowledging the possibility of deep collapse, Homer-Dixon holds out hope for catagenesis – renewal through breakdown to a simpler form, followed by the emergence of a novel form of society. He argues that in order to achieve this, we must act to attenuate the tectonic stresses we face in advance so that they will be less likely to result in synchronous failure. We must also loosen the connectivity that binds us into a tightly coupled system in order to build resilience of critical systems like food and energy. There is however, a sharp contrast between resilient systems and efficient systems, in that resilient systems maintain safety margins that look like inefficiency, an

example being power grids as they used to be run by engineers as compared with deregulated power grids run by accountants anxious to eliminate all unnecessary spending. Homer-Dixon makes a strong case for the reintroduction of relative self-sufficiency – an important aspect of resilience which has been comprehensively replaced as a guiding philosophy by comparative advantage. However, he expects resistance from vested interests.

Then there are social causes of denial. Probably the most important is the self-interest of powerful groups – corporations, government agencies, lobbyists, religious institutions, unions, non-governmental organizations, and the like – that have vested interests in a particular way of doing things or viewing the world. If outside evidence doesn't fit their worldview, these groups can cajole, co-opt, or coerce other people to deny this evidence. Some groups, of course, will be much more effective in the effort than others, owing to their enormous political and economic power.

The difficulty is that resilience represents an additional cost, which no one appears prepared to bear, especially as it would place them at a disadvantage in relation to others who took no action. In essence, the problem becomes a tragedy of the commons where resilience - a long-term public good - cannot be maintained in the face of short-term self interest in the exploitation of resources at the maximum rate, whether at the level of the individual, the corporation or the nation state.

And because our leaders hardly ever think about resilience, we keep doing things that make our lives progressively less resilient – we pile on more debt, build tract housing over our finest crop land, develop addictions to distant sources of energy, become so specialized that we can't take care of ourselves when everyday technologies fail, and fill every nook and cranny of our days with so much junk information and pointless running around that we don't have time to reflect on what we're doing or where we're going.

### **Recommendation**

The Upside of Down is an essential read for anyone interested in understanding the converging stresses of the twenty-first century and the potential implications for our current way of life. Homer-Dixon possesses a rare ability to connect disparate fields of enquiry in a clear, concise and profound manner, and to bring the resulting discussion to life. There are too few books which take a truly interdisciplinary approach and place current issues in their complex context – this is one of the best available.