MY UNFINISHED WORLD VIEW

A poem is never finished, only abandoned.
Paul Valéry

Succinctly defined, a world view is a coherent system of fundamental beliefs that describe some reality of interest. In terms of its function, the job it does for its owner, a world view presents as a thinking tool, a *cognitive technology*, which provides a first-stop mental model when seeking understanding (What's happening?) or when making decisions (What-to-do?). At its best, a world view can be a powerful sieving device which suggests, in a general way, not only what is happening but what is not happening; not only what you might do but what you should not do in puzzling situations. While a world view does not have to be coherent, meaning internally consistent, and, recognising that cognitive dissonance (holding contradictory ideas) might even be helpful on occasions (e.g. by suggesting alternative ways of viewing intractable questions), it is difficult to maintain an incoherent world view once one is aware of doing so. Notwithstanding, humans have a great capacity for self-deception in such matters.

Was Manning Clark's understanding of the Australian story as one of competition between Enlightenment, Protestant and Catholic values a world view? Yes, and a fine one according to his biographer, Mark McKenna.[1] But it brings home that world views are rarely about the world. They are about the universe, or Australia or Yackandandah. And they carry the corollary that a world view normally gains depth by sacrificing breadth, and conversely. That is disheartening for someone like myself who, deep down, is a reductionist, a totaliser. It would be so nice if the application of a few key ideas could routinely expand the breadth and the depth of one's thinking (some such comfort must warm those who think that absolutely everything can be explained in terms of physics).

Something else that is disheartening for humanists who want the best for everyone is that most people have world views that have stopped growing. People acquire and stay with a formula, a recipe, for understanding how their reality-of-interest works---unless the facts make nonsense of their perspective. How could a loving omnipotent God take my child?

One reason I continue to be satisfied with the science-based, naturalistic world view which I began to acquire as a teenager is that it is open to, indeed welcomes, revision.   Its rootstock is the belief that, *without invoking supernatural forces, continued application of the scientific method is building a growing body of plausible propositions, and raising ever-deeper questions, about the nature of reality*. A scientific world view is unfinished in the way a growing tree is unfinished, with bigger branches continuing to subtend smaller branches. Correspondingly, each new insight into the nature of reality evokes further questions and answers.   Thus, a developing (scientific) world view has an ever-branching hierarchical (equals strongly ordered) structure.

Having raised the supernatural, let me confront it. Notwithstanding 300 years of enlightenment (think for yourself), a belief that immaterial anthropomorphic forces guide the unfolding of reality is central to the world views propagated by most religions, including animism. Throughout the recent history of modern humans, terror and religion based on supernatural external authority have been the main social technologies for guaranteeing behaviour supportive of the existing social order. People who have had something of a scientific education, including exposure to Ockham's maxim that it is the simplest explanation that should be accepted, see how, in principle, the world can be understood without recourse to frightening beliefs that have no evidential basis. One reason, apart from opportunity, that religion outpolls science as a world view is that while a good preacher can spell out a coherent world view in half an hour, it takes time and effort to learn to see the world through scientific eyes.

Along with religion and science, politics and economics are the foci around which people in the western world most commonly develop world views. A Catholic free marketeer who believes in democracy already has three world views, three starting points for answering the *what's happening?* and *what-to-do?*

questions that are puzzling hir. My task of the moment is not to delve into other people's world views, but to display some of the building blocks that make up my science-based world view and say something of how these have helped me approach various *what-to-do* and *what's happening* puzzles.

I am a human ecologist (no, not a human who studies ecology), meaning that my 'reality of interest,' my research interest, centres on how, and how successfully (adaptively), groups of humans manage their collective behaviour and their longer-term interactions with the non-human environment. Just as calling yourself a classical composer commits you to working within certain rules and makes your output understandable to others, calling yourself a human ecologist commits you to certain provisional beliefs or working hypotheses.

The lowest 'branches' on my rootstock belief in science *per se*, are the dual ideas that most of what happens in human ecosystems can be interpreted as evolutionary processes---those based on selective retention of variation---or/and as ecological processes---those characterised by interdependent behaviour amongst adaptive entities like plants, non-human animals and people. While these are two powerful perspectives for beginning to understand what is happening or could happen in human ecosystems, they are of little use, by themselves, for making what-to-do decisions. For that, they need to be linked to a normative or 'prescriptive' assumption about the purpose or goals or intentions of the decision makers, e.g. economists assume people are basically materialistic. Without knowledge of such goals, candidate decisions cannot be ranked from most to least preferred (note the unstated assumption that decision-makers will have goals). Neither can one begin to speculate as to why human societies evolved as they have, influenced by both agency (purposeful rational behaviour) and the environment's whims.

In recent years, when the choice has been mine, my preferred assumption about goals has been that decision-makers seek some version of high quality of life for those they see themselves as responsible for (perhaps only themselves or including future generations perhaps). My preference reflects the humanistic personal ethic I have long held and continue to hold, humanism being a philosophy which, above all, aspires to human progress. Now we can give my world view a name: science plus humanism equals scientific humanism.

To be a useful tool for understanding and then suggesting cultural adjustments in human societies, a world view needs to be much more layered than a belief in the explanatory power of evolutionary and ecological thinking, combined with an acceptance of high quality of life as a pervasive human goal. That primary insight has to be elaborated with further insights (provisional beliefs) into how evolutionary processes or ecological processes tends to operate in particular situations. And, to complete the toolkit, ideas that elaborate the components of a quality life in various situations, and how to assess these, are needed.

To be specific, I continue to be happy enough with psychologist Abraham Maslow's *theory of human needs* as a basis for analysing quality of life. He sees people as striving to satisfy received physiological and psychological needs for life, safety and security, for belongingness and affection, for esteem, for respect and self-respect and for self-actualisation (personal development, realisation of latent potentialities). [2] As more basic needs (e.g. food) are met, attention switches, in a hierarchical fashion, to satisfying higher needs (e.g. for creative activity). A need, in general, is 'that which persons must achieve if they are to avoid sustained and serious harm.' The notion of a *needs hierarchy* leads directly to the idea that a person enjoying high quality of life is someone who is largely able to satisfy his or her higher needs.

TWO PARTICULARLY USEFUL IDEAS

When it comes to applying evolutionary and ecological thinking to human sociocultural systems, one is looking to find plausible analogues in human social organisation for powerful concepts and principles that have been largely developed for understanding purely biological systems. Here, while my thinking is glaringly unfinished, let me mention two ideas which I frequently find to be productive starting points when trying to understand what is happening in Australian or global society.

The centrality of technological change

One is the parallel between the role played by a species' *gene pool* in biological evolution and the role played in sociocultural evolution by a society's *suite of technology recipes*. Technology recipes are like genes and vice versa. Both are information carriers. Implementing technology recipes is the way in which societies maintain themselves. While mostly applied routinely and repeatedly, they can appear or change spontaneously (like mutations), after which they become available for adaptive use, i.e. as a basis for doing things differently. But, unlike gene mutations, technology (short for technology recipe) production is also a goal-seeking activity, undertaken to better satisfy human needs. This bypassing of the hit-and-miss randomness of gene mutation etc. is the reason that sociocultural evolution is normally recognised to be a much faster process than purely biological evolution.

As with biological adaptations, new technologies tend to get developed and used and remembered on the basis of their immediate or short-term benefits. A few, such as the invention of agriculture, slavery and the steam engine, are transformational, changing the structure, infrastructure and (mental) superstructure of societies everywhere. In my world view, technologies range from the material (turning stuff and energy into products and processes) to the social, meaning technologies which organise and coordinate human behaviour to create 'problem-solving' institutions. I also have a place for 'cognitive' and 'communicative' technologies. Thus, democracy and nuclear power are equally technologies.

Virtual species

A second idea I have frequently found to be fertile is that each of the various common-interest groups into which any modern society's members can be classified can be thought of as 'virtual species' which interact and are interdependent in ways comparable in many respects to the ways biological species interact in human-free ecosystems. That is, society's various interest groups, its virtual species, are like biological species and vice versa. For example, pursuing this idea, one can see that specialist *groups* in the economy (e.g. producers, consumers) are unwittingly *cooperating* for their mutual benefit---an extension of Adam Smith's recognition of a metaphorical 'invisible hand' guiding self-interested *individual* behaviours towards socially optimal outcomes.

Equally, virtual species can often be found *competing* for the same resources, as when, for example, European colonial powers occupied the New World, e.g. competing for arable land, slaves, gold. The further ecological concept of *parasitism* provides a perspective on the exploitation of one virtual species by another, a good example being the idea that we live in an imperialistic world system where there is extreme economic exploitation of 'peripheral' nations by the world's 'core' nations. In brief, the virtual species making up human ecosystems interact in a variety of ways, many of them close analogues of processes in non-human ecosystems.

In my world view, the link between the two perspectives, ecological and evolutionary, is that not only do virtual species interact with each other in line with established behaviours which we can think of as their technologies, they periodically develop and evolve new technologies intended to improve their members' survival and quality-of-life prospects. They are following the master principle of pristine systems, 'evolve or die out.' Thus, human ecosystems not only regularly reproduce themselves, they evolve over time as their virtual-species members develop and apply new social and material technologies. For example, an ecosystem with an intermingling of two virtual species, farmers and graziers, might move towards having more farmers if the farmers develop more reliable crop varieties.

EXPECTATIONS

Drawing on my knowledge of what has recurred in history and human affairs and on my understanding of evolutionary and ecological processes, my world view has come to include a 'default' set of expectations which I routinely interrogate when asking 'What's happening?' questions.

Self-interest

For example, I initially expect any virtual species to be behaving in a self-interested way. But not rigidly so; I equally recognise that social character is very malleable and that people, especially when young, can

be taught to have concern for the wellbeing of others, including strangers. While there are many technologies for suppressing self-interest within groups (e.g. shaming), most virtual species find it very difficult to wittingly cooperate with other virtual species, whether searching for compromise or win-win benefits.

This pervasive inability to agree, what I call the *virtual-species problem*, is more conventionally known among political scientists as *agonism,* a term borrowed from biologists. For biologists, agonism is that combination of aggressive, defensive and avoiding behaviours which allow members of a species to regulate their spatial distribution; and, probably, access to food and mates. Amongst political scientists, agonists are sceptical of the capacity of politics to eliminate, overcome or circumvent deep divisions within societies, e.g. of class, culture, gender etc. They find many models of political behaviour, including liberalism and communitarianism, to be far too optimistic about the possibility of finding an harmonious and peaceful pattern of political and social cooperation.[3] While most virtual species are likely to be at least sympathetic to the proposal that humans should collectively pursue high quality of life for all, any agreed program (e.g. through the United Nations) for doing so seems unlikely. Indeed, parties will find it very hard to even agree on an operational definition of quality of life.

Grasshopperism

Another of my expectations is that individuals and groups, when making what-to-do decisions, will frame and compare their behaviour options in, by my standards, an unduly narrow way, commonly by ranking a too-small number of options in terms of too-few performance measures over a too-short time horizon. Too many significant decisions appear to carry an avoidable risk of being confounded by the unforeseen but foreseeable.

Politicians, for example, are notorious for not thinking beyond the next election. Just as it takes many kilometres to change a supertanker's course, it takes decades to transform a society's values, attitudes, perceptions and institutions. Western societies' current inability to factor these sorts of longer-term implications into their decision-making processes in a balanced way is widely recognised as a blind spot that has been given a name---short-termism or, for those who remember Aesop's fable of *The Ant and the Grasshopper*, grasshopperism.

Notwithstanding, what I find myself criticising as poorly-considered myopic decisions, collective or personal, can often be plausibly explained---not defended---after a little investigation:

Of first importance here is that because it is always difficult to predict the consequences of candidate behaviours in complex sociocultural systems, it might be judged, legitimately, that the perceived benefits of attempting comprehensive decision-making do not warrant the effort involved. Taking the same point even further, until we gain a better understanding of how complex systems---those containing multiple feedback loops---evolve over time, it might be judged too costly to use so-called rational methods for making decisions, even in a superficial way. I have some sympathy for people who rely only on intuition when making decisions. But there is a middle way between relying on unharnessed intuition and attempting to tease out the full consequences of a spread of possible actions. It is to build imaginative wide-ranging scenarios (stories) of the plausible possible consequences of one's alternative actions and, only then, allow intuition to choose between these. Sometimes it is illuminating to construct scenarios of both the 'best case' and 'worst case' consequences that can be imagined..

There are other reasons, more prosaic, for the prevalence of myopic decision-making. Most people are poorly served by their education and find it difficult to think about their options in an analytical way or, indeed, even understand that they have 'options.' Equally, people find it difficult to think expansively, beyond the everyday, when asking what could happen. Also, as societies grow, complexify and specialise, 'negotiation overload' sets in. As the number of 'urgent' decisions to be made blows out, the time available to make each decision shrinks, taking its quality with it. This time-pressure effect is particularly noticeable in executive government where the goal of evidence-based policy-making is becoming harder to achieve.

FOUR HIGHLIGHTS

My world view, as it relates to the behaviour of human ecosystems, has evolved in fits and starts over the past 40 years. But I don't think it has passed through any 'paradigm shifts' in that time in the sense of my discarding an important idea and replacing it with an antithetical idea. Nor do I anticipate such a shift soon. If I sensed a coming breakthrough in science's ability to unravel the unpredictable behaviour of complex systems, that is where I would be looking to radically update my present understanding of 'what's happening' and what to do about it. But I don't.

Rather, my world view grows by selectively assimilating new ideas (meaning new relationships between entities) which support, extend or re-frame my existing ideas about how human ecosystems work. I also look for ideas which I sense, nothing more, might lead me to a new way of thinking about the processes which occur in human ecosystems. For example, recent research on the adaptive value of so-called 'junk' DNA in biological evolution makes me wonder if 'memes,' a culture's 'imitable behaviours,' play a comparable role in cultural evolution. While some of the new ideas I have assimilated have been my own, I largely draw such from my reading in, particularly, two areas. One is the biological, human and social sciences; and the other is 'comparative history,' meaning histories which follow a theme doggedly through time/space, e.g. histories of energy capture, cruelty, violence, truth…

While my list, restricted to four, would probably change on reflection, here is a group of ideas which within the time-span of this essay, have dramatically expanded my thinking:

Dissipative systems and maximum entropy

A powerful and relatively recent idea for understanding change is that all reality is made up of nested layers of *dissipative* or *energy-degrading* systems[4]---smaller, faster-running systems nestling inside larger, slower-running systems. The fundamental property of dissipative systems is that they continuously take in energy, physical materials and information (energy in the form of meaningful patterns) from their environment and continuously excrete (dissipate) materials, information and degraded energy---energy of a lowered quality in terms of its capacity to do work---back into the environment. For example, the multi-species assemblages which ecologists refer to as *communities* or *ecosystems* can, in some sense, be considered as energy-processing systems which are transforming high-quality solar energy into chemical energy and then distributing this to all of the community members to be dispelled, eventually, as heat, a low-quality (useless) form of energy. The link here to evolution is that evolution can be understood as a process which creates, maintains and destroys dissipative systems.

The *principle of maximum entropy production* is an 'unproven' corollary of the second law of thermodynamics. It asserts that, whenever such a change becomes feasible, any dissipative system spontaneously self-organises into a new state where higher quality energy is degraded into lower quality energy more rapidly than in its previous state; and it keeps moving, step by step, through a sequence of feasible but unstable states towards a stable state where energy is being degraded (i.e. entropy is being produced) at a maximum rate. So, while energy can be neither created nor destroyed (first law of thermodynamics), the evolution of the universe conforms to the constraint (and strict selection principle) that higher quality energy is always being degraded to lower quality energy as fast as is physically possible. For example, it can be shown that the world's system of winds and ocean currents transfers heat from the tropics to the poles as fast as is physically possible.

Usually of course, this principle won't be particularly helpful for constraining (narrowing down) what might happen next in any local situation. Notwithstanding, it is intellectually very satisfying to always have a first order answer to any 'What's happening?' question. Dissipative systems and maximum entropy are the metaphysical foundation of my world view.

Universal selection

Since Darwin's time, the basic idea behind evolution through natural selection, namely, the *selective (non-random) retention of variation,* has been co-opted to explain evolutionary change in all manner of

systems. Under the banner of *Universal Darwinism* or, to be less biological, *Universal selection*,[5] temporal changes in various physical, chemical, psychological, cultural (including economic and technological) and other types of systems have been 'explained' using one or another version of this powerful idea. For example, solving problems by 'trial-and-error' involves generating a sequence of potential solutions until one which works is found and adopted, i.e. selected and retained. My particular interest lies in applying universal-selection thinking to cultural evolution, e.g. seeing cultural evolution in terms of the selective (trial and success) retention of newly-formulated technologies.

Every dissipative system has a finite life

This, first, is the idea that all of the universe's dissipative systems have come into existence by diverting portion of the material-energy flows in some parent system into an offspring system which, while processing material less rapidly *in toto* than its parent system, processes more energy per unit mass than its parent, i.e. it is, according to Eric Chaisson's ideas, more 'complex' than its parent.[6] If material-energy flows being drawn from the parent system surge or decline markedly for any length of time, the offspring system will, metaphorically speaking, 'die,' starved or overwhelmed as the case may be, e.g. when the sun dies, our biosphere will die.   'Dying' means that the offspring system's structure---its network of transport channels and 'transformation nodes'---is substantially destroyed.

But even in the absence of gross changes in the flows of materials and energy in the parent system, offspring systems typically pass through a birth-to-death life cycle characterised by three stages--- immaturity, maturity and senescence. Nothing lasts forever! An immature system is a system which keeps growing by developing structures which capture increasing quantities of the parent system's material-energy flows, e.g. a plant grows more light-capturing leaves. The specific (or relative) growth rate of an immature system increases over time. A mature system is one whose specific growth rate has started to fall because it is approaching a constraint, a limit to the material-energy inputs it can capture for its further growth, e.g. a plant canopy which is capturing all incident sunlight. A maturing system needs to add ever-more structure to capture each additional unit of energy, e.g. think of the rising unit cost of exploiting depleting oil fields.

At some point every mature system becomes senescent, meaning the system has more-or-less stopped growing and is using most of its energy flow to maintain (not grow or adapt) its existing energy-capturing and energy-processing structures. In such a state, the offspring system is processing less energy per unit mass than its parent system and becomes vulnerable to small random fluctuations in material-energy flows (called homeostatic weakening or loss of 'bouncebackability') either within the parent system or within the transport channels of the offspring system. In a senescent system, small fluctuations will eventually precipitate a loss of structure and a decline in the system's capacity to capture energy flows from the environment and dissipate energy back into the environment. Once initiated, loss of structure spreads, domino-style, as the closure of one transport channel leads to the closure of all channels connected to it; although a *resilient* system may be able to switch to alternative channels. Think how the loss of one line in a power grid has sometimes closed down the whole grid.

Memento mori. Locating a system (you, me, the universe) within its putative life cycle focuses one's view of it remarkably, as Samuel Johnson might have said.

Consciousness is a recently evolved cognitive technology

Consciousness remains a puzzle for psychologists, neuroscientists and philosophers alike. My current working hypothesis, drawing on the ideas of Julian Jaynes[7] and Zoltan Torey[8], is that it is a cognitive technology for helping post-infantile humans decide what to do in situations where neither habit, custom, nor instinct provide a behavioural template, and something more than blind trial-and-error is required. As recently as the 1st century BCE, it evolved from and replaced what Jaynes calls the *bicameral mind*, an earlier cognitive technology in which a single behavioural response is formulated at a sub-conscious level and acted out in obedience to an insistent hallucinated command, often in the voice of a leader, king, god or other authority figure.

Consciousness, by contrast, is more like a dialectical dialogue with oneself. It allows the pre-conscious to throw up 'solutions' to a what-to-do problem, one after the other, describing each in words, albeit silently, until a solution is reached which is both plausible (i.e. appears to be implementable) and emotionally acceptable.

'Yes, but do you have any other suggestions'?

'Ah, thankyou, that's "good enough."'

Both the bicameral mind and consciousness are language-demanding technologies meaning neither could have evolved before language evolved (and, in passing, that babies cannot use this technology). Consciousness uses sub-vocal language to efficiently convey a tentative solution to a what-to-do problem across the corpus callosum, from left to right hemisphere, to a site where it can be evaluated for its acceptability. The bicameral mind uses language to convey an hallucinated command over the same pathway. The changeover in technologies may have been facilitated by the increasing failures of authoritarian commands in tumultuous times and by the flowering in Greece of a vocabulary for describing one's thoughts and feelings in terms which recognised such to be self-generated, e.g. I feel sick. Consciousness is a *social technology* to the extent that without the language we learn from others, it would not exist.

Consciousness, a process, is different from 'being conscious' which is an experience. Being conscious is an experience of seeing, metaphorically, that one's problem-detecting processes are currently receiving information about something, from either internal (pre-conscious) or external (sensory) sources. Because it is difficult (but not impossible) to be conscious of something one cannot describe, the range of 'somethings' one can be conscious of expands with one's vocabulary. Speech can be an indicator of the experience of being conscious; if you can hear yourself describe or refer to something, a thought or sense impression, it can be assumed that you are or were conscious of that something.

What-to-do problems can range from 'fight or flight' to where to put a comma; from how to classify an object (What bird is that?) to ascribing causes (Nature or nurture?) to checking patterns (Has something changed here? Do I have a problem?).

Consciousness deals with problems constructed by oneself as well as problems presented by the environment, e.g. How do I devise a piece of music within the following compositional rules? The very use of language generates its own suite of what-to-do problems, e.g. what is the definition of gollywog?

These then are some of the enormous ideas that have come my way. Several are strange and I ask the reader to not reject them too quickly. While I hope there are more grand ideas to come, I expect, at very least, to be regularly amazed and pleased at humanity's growing understanding of nature and society. More prosaically, I will be looking for 'factual' generalisations and concepts which I can add to my world view's stock of working hypotheses or, less elegantly, 'rules of thumb.'

WHERE TO NOW?

Let me close by listing some of the bigger and smaller questions which I need to continue researching if I am to become a more insightful human ecologist. Some of these reflect no more than a wish to redress my ignorance of a particular body of literature but others stem from more informed doubts about the robustness/ adequacy of various of my current hypotheses; or, conversely, an intuition that some existing idea can be improved:

Language and adaptation

Language and writing are humanity's greatest inventions, supreme tools for communicating and creating information, both inside heads and between people. Without them, complex societies and the social, material and cognitive technologies which sustain such societies would not be possible. People have always lied, but is language becoming a maladaptation now that it is so widely used for propaganda,

disinformation, emotional manipulation, framing etc.? Just what is a maladaptation? How does one diagnose maladaptation? When can a maladaptation prove fatal? When trust is lost and all information is suspect? Should we be surprised at this debasement? Can language be rescued without emasculating it? Is the counter-enlightenment finally winning? How does language constrain and enhance entropy production? What more can be done with this tool? Does it have unrecognised potentialities? Is language, as distinct from vocabulary, still evolving? Is all language metaphorical and, ultimately, private? What is the relation between a society's or an individual's world view and their vocabulary?

Culture and technology

How powerful is the idea that cultural evolution can be largely understood in terms of the evolution and ecology of technologies and ideas? I am very attached to this reductionist proposition, but am I asking too much of it? Have I just rediscovered cultural materialism and technological determinism? How do technologies evolve and spread? Do stable, persistent technologies provide a nurturing environment, one where fragile technologies can emerge and adapt to those that are enduring? How do technologies co-evolve? Does a new recipe have to be used repeatedly before it can be called a technology; for example, is a revolution a social technology? Can methods of foreseeing the full consequences of new technologies be improved? How does one develop maximally useful technologies? What triggers the search for new technology? What limits what is technologically possible? What role do emotions and consciousness play in technological change? What is the relationship between technologies and ideas? Can technological change explain giant social transformations?

Agency and idealism

When do ideas change the world, e.g. the Protestant ethic and the rise of capitalism? In what ways do ordinary individuals contribute (a) to reproducing (maintaining) society and (b) to changing society? Under what conditions can would-be reformers achieve significant reform? Under what conditions can power-seekers achieve power? Is agency something more than conscious rational behaviour subject to the constraints of being a member of society? How did it evolve? What motivates or causes goal-seeking behaviour? Is it reasonable to assume that agents are constrained to be rational? Can individuals make decisions which violate the principle of maximum entropy production? What are the bio-physical and social limits on agent behaviour?

Cognitive technologies

Is there a place for rational thought in a world where nothing can be proved or disproved? How useful is the concept of 'bounded' rationality? Are plausible evidence-based stories a good-enough cognitive technology for provisionally understanding nature and society? What are the alternatives? What does *plausible* mean? Does quantitative modelling have a role in understanding the world? What is an *explanation*? Is a moral code a cognitive technology? How does a person's world view determine their choice of cognitive technologies? How can cognitive technologies be best classified?

Virtual species

All individuals belong to a variety of virtual species or interest groups and frequently move between these; how should the dynamics of these oscillations be conceptualised? Can virtual species be usefully thought of as occupying ecological niches---nodes in a network of nodes, each of which can be described in terms of their imports, exports and transformations of materials, energy and information? How will this description change between steady-state and evolving societies? How do virtual species choose their collective actions? When is it useful to think of the populations of city regions (that is, cities plus their hinterlands) as virtual species? How do people become members of a virtual species? How does the membership of a virtual species grow? How does a network of niches grow or contract? How does one virtual species manage to exploit another? What are the limits to such exploitation?

The questions are legion and time is short. I accept that my world view will remain unfinished. As Homer said, 'The journey is the thing.'

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