

A Dream is a Broken Story

The History of Economics as a False Dream

Brett Wilson

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A Dream is a Broken Story

Part One: Dumb Smart Guys: The Assumptions and Disasters of Economics.

A hundred and fifty years ago the economics of Adam Smith was remade in a new image. A theory of how economies developed and fluctuated was put forward by Leon Walras, Vilfredo Pareto and William Stanley Jevons. They had discovered, they said, that the markets which determined the wealth of nations, behaved like the physical systems described by Victorian physicists. They said that all large scale systems tended towards equilibrium. By understanding how this happened, markets could be controlled and the dangerous events that might plunge society into chaos and destruction could be held in check. This is the story about how these theories have become accepted by those in power, and the dangerous and unexpected ramifications of that acceptance.

It was Adam Smith who recognised that it was self interest that drew people to provide goods and services¹: 'It is not from the benevolence of the butcher, brewer or baker that we expect our dinner, but from the regard to their own interest.' And 'Every individual is continually exerting himself to find out the most advantageous employment for whatever capital he can command.' It was Smith's assertion that it was this pursuit of self interest that would benefit society as a whole. Smith described, in *Wealth of Nations*, how price acted as a key mechanism, rising and falling freely to bring supply and demand into balance. Following Smith's discovery, thinkers went on to describe in more detail how societies would balance the needs of its citizens by the mechanism of price. But there was one problem. No one knew how to calculate or predict what the price should be.

Beanz
Meanz
Heinz

The economy depends about as much on economists as the weather does on weather forecasters

What happened next gave economists the belief that they *could* calculate price and hence be successful in controlling the economy. In 1872 an economist named Leon Walras proposed a mathematical theory that he said could do just that. Walras, along with Jevons and Pareto, were convinced the equations of differential calculus, that could be used to describe the motions of planets and the trajectories of cannon balls, could also capture the motion of the economy. They likened the economic system to a physical structure. As Jevons stated: 'The notion of value is to our science what that of energy is to mechanics' Walrus proclaimed: 'The pure theory of economics is a science which resembles the physico-mathematical sciences in every respect' and Pareto declared 'The theory of economic science thus requires the rigour of rational mechanics.' But what they were creating was the image of a Panglossian economy where through trading, the system glides to an equilibrium, a natural resting point where supply meets demand, where resources are put to their

¹ The Wealth of Nations (1776).

most efficient use, and where the utility to society is optimal. What they didn't realise was that what they were creating was a theory riddled with unsustainable assumptions, painted over with the gloss of mathematics.

The twentieth century has been one in which the dream of an effective economic science has failed to materialise². Nearly all catastrophic macroeconomic imbalances, from inflation in the Weimar Republic in the 1920s and the American Great Depression, to Argentinean debt default and Japanese stagflation in the 1990s provide ample proof that orthodox economic theories are inadequate. Despite this, there has emerged a complete theory, beginning with axioms about the behaviour of consumers and producers, rendering over-arching conclusions about markets and economies. These theories now determine the way economists look at the causes of unemployment, inflation and asset values.

A Mars a Day helps
You Work, Rest and
Play

I'd call it a new version of
voodoo economics, but I'm
afraid that would give witch
doctors a bad name

Let's consider, for the sake of simplicity and without loss of generality, the period from the late 1970s onward in the United Kingdom. Britain in the 1970s was at an impasse.

Throughout the twentieth century various mass social movements had led to the reigning back of the free market, or what Karl Marx would have described as capitalist power, as well as producing socially beneficial transformations in society itself. World wide we saw the suffrage movement politically enfranchise women, and in the UK a welfare state and universal free healthcare was established. The general ethos of collectivism, in part derived from the spirit of World War 2, lasted well into the 1970s but had already lost ground to the individualist youth culture, which originated a decade earlier. In the late 1970s the Conservative government of Margaret Thatcher, in part riding this new wave of individualism, came to power. They had decided to adopt the ideas of the Chicago School of economics, led by Milton Friedman, and gamble they could cure the economy of stagflation, something that had afflicted most Western economies. Their first step was to begin reducing the money supply in the UK. In doing so they had implicitly accepted the assumptions of Walrus, Jevons and Pareto. But within two years, unemployment had risen by two million, far greater than the theory had predicted and the government was forced to reverse direction. The predictive ability of economic theory had once again failed.

A realist and an economist are taking a walk. The realist looks down and spots a £50 note. "Look" says the realist. "A fifty pound note" Without looking the economist says "Nonsense. If there had been a fifty pound note lying in the street, somebody would have picked it up by now"

² On October 29th 1929 the Wall Street crash began. The Great Depression is thought to have got underway in the same year, resulting in mass unemployment and poverty on an unprecedented scale. These events were not predicted by the economists of the time, and some began expressing doubts (when Walrus asked Henri Poincare, the mathematician, for his opinion, he replied 'You regard men as infinitely selfish and infinitely far sighted. The first hypothesis may perhaps be admitted in a first approximation, the second may call for some reservations.')

The basis of this economics was the foundational notion of rational, optimising consumers in a world of finite resources. But in previous decades, economies had suffered the oil shock, sovereign debt default and several asset bubbles, so although neo-classical economics was unchallenged, there was a growing disquiet among those in business. Joseph Stiglitz, former chief economist at the World Bank and Nobel Prize winner went as far as to say: 'Anybody looking at these models would say they can't provide a good description of the modern world.' The economist Werner Hildenbrand compared general equilibrium theory to a gothic cathedral, of which Walras and his contemporaries were the architects.

When Walras and Jevons imposed the concept of equilibrium from physics, they gained precision but lost realism,

An economist is an expert who will know tomorrow why the things he predicted yesterday didn't happen today

because the highly restrictive assumptions they had to make detached theoretical economics from the real world. They assumed that people always pursue their self interest with perfect rationality and with perfect information. So if faced with the

problem of how to invest their savings they would follow their self interest in fantastically complex and calculating ways, mirroring the economist's mathematical expertise. They would do this in a world without ambiguity, and with no time or cost required to acquire information. Economists assumed that it was OK for economies to run in abstract time, such as the rounds in Game Theory or generations in macroeconomic models. Few models have time in the sense of hours, days and weeks. When economies were pushed off balance, this would be rationalised as an exogenous shock. This gave economists an escape hatch. It allowed them to treat such changes as random and outside economics itself, not needing explanation.

But in 2008 a crisis in banking occurred which almost precipitated a collapse in the global financial system. A huge asset bubble had formed in the US property market. The banks had created complex financial products which were the same assets repackaged in what was meant to be a low risk investment and these were traded all over the world. These products were traded by banks without them really understanding the nature of the risk. In 2008 an American bank, Lehman Brothers, became the focus of a liquidity crisis based on falling property values, and went to the American government for help. When they were refused, the bank collapsed. What followed was a series of beggar thy neighbour policies by the rest of the banks which further reduced the interbank lending supply and put several banks under strain and unable to meet their commitments. Without a massive fiscal stimulus package by governments, it is likely that the global financial system would have crashed.

What had occurred in the Western economies was an asset bubble, fuelled by cheap credit. Those in political power had unwittingly colluded with a powerful group they had helped create. The politicians claimed they had unleashed the

Yes
We
Can

power of the financial sector by deregulating how it worked. They believed that this would generate huge wealth for the economy. But instead they had created a self serving cadre with whom they had embarked on a fatal relationship. Aided and abetted by economists like Alan Greenspan, every time the US economy showed signs of cracking, the administration responded by making even more credit available. Greenspan and his allies were so convinced that their understanding of economics was correct, that they failed to see the danger.

Part Two: The Modern Games:
How John von Neumann and John Nash Changed the Game.

It has been more profitable for us to bind together in the wrong direction than to be alone in the right one.

I have already written about how Game Theory had been taken up by economists in the mid twentieth century and how its narrow purview led to a restricted view of human nature. As the joke goes: rational agency works perfectly as a description of behaviour as long as it is only applied to economists and sociopaths. But how

did Game Theory arise and why was its adoption so rapid? To explain this we must return to Second World War Princeton. When John von Neumann and Oskar Morgenstern published their Theory of Games and Economic Behaviour in 1944 mathematics was still being practised with, and I hope they would excuse the phrase, a sturdy Catholicism. The pressure to obtain practical results in wartime and the inheritance of a number of assumptions meant that issues which strike at the heart of the question of the ubiquity of mathematics and as a result, its limitations, were ignored.

Let's start with a simple definition. Game Theory is the attempt to quantify and bring logical rigour to strategic decision making. Its graphic representation is also simple and it's called a decision tree. Each branch represents a decision and the genius of Game Theory is to quantify them. When you reach the end of the branch you reach the payoff. It's rational, economists assume, for an individual to maximise the payoff. But what happens when there is more than one player? In such cases we are trying to describe how general characteristics of a network of decision makers will change given an initial state.

In practice, most networks are found to have what are called soft spots. These are points that more profoundly affect the system than others. The sensitivity of such a spot does not appear to be a fixed characteristic of a system and in addition we may be confronted by systems which have none. There are some general notions which are useful. The first notion is *lock-in*. Lock-in takes

The ideas of economists and political philosophers, both when they are right and when they are wrong are more powerful than is commonly understood. Indeed, the world is ruled by little else. Practical men, who believe themselves to be quite exempt from any intellectual influences, are usually slaves of some defunct economist.

place when components tend to confine attention to a restricted number of points in the system. A good example of this is when a general discussion gets locked in to some specific issue. With neither side giving in, both sides remain in a state of dynamic paralysis. There is thus the state of an iron ring or vicious circle. A second notion coined by the anthropologist Gregory Bateson is *schismogenesis*³. It involves two parties in which the behaviour of one provokes the other into going further in the behaviour to which the first party is reacting. Typical examples are the arms race, and keeping up with the Joneses. The relationship of authority and subservience is another example. The bullying attitude of one produces a humble reaction in the other, which further reinforces a more masterful attitude which produces more subservience⁴. A third notion is the double-bind. Here three components are involved. The way *a* reacts with *b*, makes it difficult for *b* to react with *c* properly.

Although these notions are useful they are not comprehensive enough to describe aggregated economic behaviour. This is where John Nash comes in. Nash's theory, describes how populations reach classical equilibrium through decision making⁵. If all players play rationally the system is driven to what is called the Nash equilibrium, which maximises the payoff for an individual, given the existence of other rational players who are also seeking maximum payoff. If the payoff is money, then what is being described is a mathematically precise analytical model for economic stability consistent with classical economics.

Part Three: Pandora's Doll: Be Careful What You Wish For.

It is true that the virtues which are less esteemed and practiced now - independence, self-reliance, and the willingness to bear risks, the readiness to back one's own conviction against a majority, and the willingness to voluntary cooperation with one's neighbours - are essentially those on which the case for an individualist society rests. Collectivism has nothing to put in their place, and insofar as it already has destroyed then it has left a void filled by nothing but the demand for obedience and the compulsion of the individual to what is collectively decided to be good.

In the first section I described how nineteenth century economists defined a series of unrealistic assumptions about human behaviour. In the twentieth century the same assumptions led to a fundamental

misunderstanding of economic reality, and at the heart of this misunderstanding was the idea that human beings behaved as rational agents operating in perfect markets. But this idealised view also spread beyond

³ Meaning chasm or cleft.

⁴ Lock-in and schismogenesis are closely related in logical structure to some zero-sum games. For example "Auction a Dollar" invented by Martin Scubik (see Social Traps by John Platt), allows two bidders to bid for a dollar. However, the auctioneer is allowed to collect two highest bids (instead of the usual one). Starting at 5 cents and bidding in 5-cent increments, the bidder is compelled inexorably to increase his bid so that he does not lose his stake for nothing. When the bidding exceeds a dollar the game gets even more vicious. Even the winner is going to lose money as he is now paying more than a dollar to win a dollar. The way out of this dilemma is to allow the two bidders to collaborate in some way. Other ways of tackling lock-in and schismogenesis are to try to affect all points in the system simultaneously, or to change something outside the system, which is strong enough to cause the contribution of the LI and S to be reduced in importance as a whole.

⁵ Nash's PhD Thesis *Non-cooperative Games* was presented in May 1950.

economics into business, politics and society. What this new way of thinking promised was the idea that human beings could be set free: set free from overbearing political control, set free from class and pre-destined roles, set free from poverty, and even set free from family.

Beginning with the assumptions of the economists, a handful of intellectuals amplified and promoted a false notion of individuality so that rational self interest has become identified with the notion of being free. A number of thinkers in the twentieth century had a strong influence on social theory. Friedrich Hayek and James Buchanan, began as economists but later became influential as social theorists. Isaiah Berlin contributed to the debate on political and social freedom, while Richard Dawkins proselytised the idea of the selfish gene. Let's consider each in turn.

Friedrich Hayek was born in 1899. He is best known as a defender of free market capitalism, but what is less well known is his contribution to systems thinking. Hayek believed in what is known as *spontaneous order*, believing that human beings behaving selfishly would produce social harmony. When asked whether altruism had any place in his description of society, he replied flatly: 'No'. He was hugely influential, founding the Institute of Economic Affairs, the free market think tank that inspired Thatcherism. During Mrs Thatcher's visit to the Conservative Research Department in 1975, she interrupted a speaker who was delivering a speech on the *middle way*. She pulled out Hayek's book *The Constitution of Liberty*⁶ and slammed it down onto the table. "This," she said sternly "is what we believe." Mrs Thatcher approached Keith Joseph, then director of the Hayekian Centre for Policy Studies, and hired him as secretary of state for industry. Likewise, Ronald Reagan appointed a follower of Hayek, David Stockman.

Economics was like psychology, a pseudoscience trying to hide that fact with intense theoretical hyperelaboration.

Like Hayek, James Buchanan was influential. He asserted that labelling certain observed behaviour as *self sacrifice* and *altruism* was incorrect. In fact, it was an illusion. A proponent of public choice theory, Buchanan said that there was no such thing as the public interest. There was only what the politician and civil servant *thought* was the public interest. This notion was

to undermine the idea that politicians and civil servants worked for the public good. Buchanan's description of British institutions was taken up by the Conservative government in the 1980s. Because there was no agreed version of the public good, he said, politicians and civil servants schemed and strategized. While they claimed to be helping others, they were really building empires and increasing their own power. It was this that had led to the ruin of the economy. These interests would now be attacked and destroyed, in favour of personal freedom.

⁶ Published in 1960.

Both Hayek and Buchanan began their careers as economists, but Isaiah Berlin was a public intellectual who studied as a philosopher⁷. Berlin defined two forms of liberty. Positive Liberty, Berlin said, was susceptible to rhetorical abuse and he mistrusted it. He had lived through the Bolshevik revolution and experienced the totalitarian state of Soviet Russia. So Berlin advocated Negative Liberty. He said: 'a person or group of persons... is or should be left to do what he is able to do or be, without interference from other persons.' This concept was perfectly in tune with the shift towards self-expression in the youth culture of the 1960s.

Richard Dawkins published *The Selfish Gene* in 1976. The timing was perfect. Dawkin's central idea was that the 'extended biological apparatus' that carried the genes around i.e. the living creature (what Dawkins calls the *phenotype*) is a vehicle for gene expression and the life of the creature is better understood in those terms. At the time, western economies were struggling against unionist power and a swell of resentment was growing against various forms of collectivism. Although Dawkin's ideas were about biology and evolution, and he warned against applying them too literally to social situations, the idea acted as a powerful metaphor for the notion of the simplicity and common sense of individualism, since nature itself was individualist.

The rise of game-theory, of Hayek, Buchanan and Dawkins fed the swell against collectivism, culminating in the naked capitalism of the late 1980s. The assumptions of Game Theory were precisely those defined by nineteenth century economists. These assumptions had led to a fundamental misunderstanding of economics, and at the heart of this misunderstanding was the idea that human beings behaved as rational agents. But this idealised view also spread beyond economics into business and politics. What this new way of thinking promised was the idea that humanity could be set free. But instead of being set free, people began to think of themselves in the narrow terms set out by the intellectuals who borrowed the same assumptions as the economists. The notion of an individual as a rationally self interested being had become identified with the notion of being free. What some of the greatest thinkers of the twentieth century had done was create something very different from what they intended.

Part Four: Wildfires: Self Organising Criticality and Disaster.

We have seen how the economists of the 19th century created economic science in the image of equilibrium theory. To do this they had to simplify their model of human behaviour. Humans, they said, were rational profit seeking agents who operated in perfect markets. But they were wrong. Instead, human beings often behaved irrationally and as a result the predictions of economists failed again and again.

The sciences do not try to explain, they hardly even try to interpret, they mainly make models.

⁷ For more information on Hayek, Buchanan and Berlin see Adam Curtis' documentary *The Trap*.

During the 20th century a number of failures led some to question the very foundations of *the dismal science*. In 1987 an international bank, Citicorp, agreed to fund a cross disciplinary workshop on economics. On one side were

The purpose of models is not to fit the data, but to sharpen the questions

ten leading economists headed by Nobel Laureate, Kenneth Arrow. On the other, were ten physicists, biologists and computer scientists, who included David Ruelle a pioneer of chaos theory. Each side presented the current state of the field and then spent ten days debating economic behaviour, technological innovation, business cycles and the workings of

capital markets. What shocked the scientists was the realisation that economic theory was a throwback to another era. It seemed as if economics had been locked in a century long intellectual embargo, disconnected from the scientific progress going on around it, but ingeniously tinkering, repairing and updating its theories in order to keep running. The mathematics taken from physics by Jevons and Walras had not changed at all. What was also evident to the physicists was the way economists had employed assumptions in their theories. Although scientists use assumptions to simplify their conjectures, they are also careful to ensure that the influence of these assumptions is minimal. Of particular concern was the assumption that human behaviour was always rational. The highly restrictive assumptions necessary to make the theory work had detached traditional economics from the real world. That is why there is little empirical support for so many core ideas in economics.

But if the economists of the late nineteenth century had looked more closely at the physics, they might have noticed something strange, something which was concerning a mathematician of the time. That mathematician was Henri Poincare. Poincare had noticed that when you try to apply Newtonian mathematics to more than two objects in space, the theory was unable to predict precisely what those objects would do. This came to be called the three body problem, and the reason Newton's theory did not work, was that it was restricted in its application to what we now call *linear problems*. These problems occur in situations that are so simple that only the calculus of the time could be applied successfully. What scientists had been doing since Newton's day was carefully avoiding complexity, since they had no way to describe it. Poincare was unlucky. He was unable to develop his insight due to the inadequacy of the mathematics of his day, but if he had been born a hundred years later, he would have had the perfect tool with which to investigate the problem, and that tool is the computer.

We have seen how the economists of the 19th century created economic science in the image of equilibrium theory. To do this they had to simplify their model of human behaviour. Humans, they said, were rational profit seeking agents who operated in perfect markets. But suppose systems do not always tend towards equilibrium?

It may be that universal history is the history of a handful of metaphors.

In June 1988 a lightning strike from a summer storm sparked a fire in Yellowstone National Park in the USA. By late August, 200,000 acres of the

park were burning. Over the next two months more than 10,000 fire fighters attempted to arrest the blaze. The fire eventually consumed in excess of 1.5 million acres of parkland. Only the first snows in autumn arrested the inferno and stopped it from consuming the park. Somehow an insignificant bolt of lightening had created a catastrophic firestorm. How?

The known is finite, the unknown infinite. Intellectually we stand on an islet in the midst of an illimitable ocean of inexplicability. Our business in every generation is to reclaim a little more land.

In the previous year, three physicists, Per Bak, Chao Tang and Kurt Wiesenfeld, began playing a simple game. They were trying to imagine what would happen when grains of sand were dropped one grain at a time onto a flat surface. What they found intrigued them. As the sand pile grew and its sides became steeper, it became ever more likely that the next grain would

trigger an avalanche. As a result, the pile of sand alternately grows and shrinks in height. What Bak and his colleagues did next was to transfer the experiment to a computer. They decided to look at the sand pile from above and colour different areas according to steepness. Where it was flat, they coloured it green, but as it got steeper they coloured it red. What they found was that as the pile grew, the green became infiltrated with ever more red until the red areas formed a dangerous skeleton of instability. This was a clue as to how cataclysmic events could erupt. Once such a network had formed a single grain of sand could cause a catastrophic avalanche. The scientists decided to call this hypersensitive condition, the *critical state*. What they and others went on to discover that so astonished them was that this state is self organising. Keep dropping grains of sand, and the sand pile will always tend to move towards the critical state. The concept is known as *self organising criticality* and it turns out that it is ubiquitous in the physical world. It can explain why a lightening strike can cause a conflagration, why a small shift in the earth's crust can produce a devastating earthquake, or an adaptation in an ecosystem can wipe out whole species. It is even applicable to human culture, and has been used to model how a simple idea can radically alter the intellectual landscape⁸.

If you hear a "prominent" economist using the word 'equilibrium,' or 'normal distribution,' do not argue with him; just ignore him, or try to put a rat down his shirt.

The financial meltdown of 2008 had many of the characteristics of the great fire in Yellowstone Park. For a hundred years park rangers had been snuffing out small fires as part of a management programme. What they had been inadvertently doing was building up a network of tinder, stretching over the

whole park. They were acting as agents, promoting a critical state. The actions of the financial authorities followed a similar pattern. Whenever a problem threatened the system, they snuffed it out with fiscal stimuli, laissez faire interpretations of financial limits, and changes in money management laws. These actions created a web of instability and pushed the system

⁸ A thorough description of self organising criticality and an account of the fire in Yellowstone National Park can be found in *The Origin of Wealth* by Eric Beinhocker (2006).

nearer to the critical state, in which a small series of events could ignite a financial cataclysm. What began as an insignificant number of defaults on mortgage loans in the American suburbs, grew into a wildfire that went global.

Part Five: The Processing Limit of the Hunting Party:
The Limits of Design and the Design of Virtual Reality.

Although the great fire in Yellowstone, wreaked destruction on large areas of natural habitat, much of the park was unaffected, since an early snow arrested the fire. Today the park remains in a critical state and a policy of controlled burns is being used to mitigate the danger. The global financial system also remains in a critical state. The actions of politicians, financiers and regulators who managed the financial system of the previous ten years, was like the action of forestry management at Yellowstone. Policy change has been slow, hindered by the warning that any action could send global economies into depression.

We have seen that the assumptions of the 19th century economists were modelled on the physics of the time. But we now know that physicists had been selecting simple linear systems, because they were the only ones they could describe. During the twentieth century, Game Theory refined the notion of human beings as rational agents. This notion was ideal for classical economics because it enabled them to produce credible mathematical theories about aggregated human behaviour. We have also seen that these ideas became widespread. So much so, that our notion of personal freedom became identified with rational self interest. This further created a favourable milieu for classical economics to remain unchallenged.

Today the network of relationships linking the human race to itself and to the rest of the biosphere is so complex that all aspects affect all others to an extraordinary degree. Someone should be studying the whole system, however crudely that has to be done, because no gluing together of partial studies of a complex nonlinear system can give a good idea of the behaviour of the whole.

But the idea that economic systems always tend to equilibrium is false, the empirical confirmation is lacking and the analytical model is narrow. We have seen how a simple computer model can produce a virtual reality in which we can play out the multiple

assumptions required to investigate human agency. I have christened this ability to reconfigure the baseline of computer virtual reality *flexible agency*. This form of agency is a feature of computer virtual reality, or virtual reality 2.0 and this begs the question: what is (or was) virtual reality 1.0? To answer that question, we need to construct a thought experiment, we need to go back in time, 10,000 years, or perhaps far longer. We don't know when humans developed language and our insight into how language appeared is scant, but it has been speculated that it must coincide with the appearance of symbolic thought⁹. But the answer is, we simply don't know. With this in mind, let's consider the hunting party....

⁹ Anarcho-primitivists state that symbolic culture filters our entire perception through formal and informal symbols and separates us from direct and unmediated contact with reality. It goes beyond just giving things names, and extends to having an indirect relationship with a distorted image of the world that has passed through the lens of representation.

When the party go out to hunt it's necessary that each hunter influence those around him. Without this influence it makes little sense to describe the hunters as a party at all. Before language evolved, it was the instinctive emotional reaction to near neighbours that bound the group together and gave it the emergent property of a 'single mind'. As the group functioned in real time, its protocol (the grunts and growls), would produce a hardwired limbic response in those in earshot. Relics of this system still exist in our expression of pain, frustration and pleasure. This is an example of distributed real-time processing, able to function largely without a command system or hierarchical control. Each unit in the system responds to others around it, operating a small number of implicit rules with incentives to stick to them. The processing limit of the hunting party is reached when the reactions of the individuals cannot be propagated quickly enough for the system to react properly as a whole. When you encounter a traffic jam, the first time you notice is when your car comes to a stop. By then it is too late.

Too large a proportion of recent "mathematical" economics are mere concoctions, as imprecise as the initial assumptions they rest on, which allow the author to lose sight of the complexities and interdependencies of the real world in a maze of pretentious and unhelpful symbols.

At some later time, humans developed the ability to create virtual reality in their heads, or virtual reality 1.0, but the key is how this came to be shared. Wittgenstein noted¹⁰ how the act of speaking or writing must

be considered to be the thought itself, because the world objectively interpreted does not include the minds of others, but is only made up of acts of writing and speaking. It is our imagination that assumes minds like ours are the correlates of these acts and it is our virtualisation of these other minds which is the turning point: only when we are able to imagine the interior world of another does language makes sense. Language is the exteriorisation of virtual reality 1.0. With it, we are able to communicate possibility and abstraction. Abstraction gives the hunting party rules, tactics and hypertheticals, and crucially it creates the version of reality it thinks reality is, until it encounters a contradiction and has to think of something better. Its abstraction into patterns, codified in our mathematics is limited to linear problems. Any complexity we encounter is gradually removed by the learning process, filtering perception into simple choices and reaction into habitual responses. We consider learning successful when as Bertrand Russel said, practice abolishes the need for further thought.

When a group has grown above a certain size, the utility of virtual reality 1.0 is magnified. Problems can now be solved by abstraction from their context. Although the hunting party is larger and no longer a whole, the party is more effective, more efficient. Since its inception, abstract language has gradually

"It is debatable whether humans are "hard-wired" for symbolic thought, or if it developed as a cultural change or adaptation, but, according to anarcho-primitivists, the symbolic mode of expression and understanding is limited and deceptive, and over-dependence upon it leads to objectification, alienation, and perceptual tunnel vision. Many anarcho-primitivists promote and practice experimenting with and developing unique and personal modes of comprehension and expression." http://en.wikipedia.org/wiki/Anarcho-primitivism#Critique_of_mechanical_time_and_symbolic_culture.

¹⁰ In the Blue Book.

become preeminent in problem solving¹¹. Even though we might distrust solutions generally outside our understanding, there is now a refusal to think in any other way. There are many examples of virtual reality 1.0 and its ongoing failure, for example economics, but despite this, when it fails, this is thought to be a symptom of the failure of its implementation, not virtual reality 1.0 itself.

There are three core problems: complexity, mind and language. Each of these areas can be associated with characteristic difficulties. Each has evolved responses. So for example language assists the mind in coping with limitations of mind (particularly memory), mind has developed habits to help it cope with complexity. But irreducible complexity presents a severe problem because, regardless of the propensity for learning, the mind's response to complexity is to try to discover hidden order (where it exists) and so render an irrelevant residue of complexity. That is to say, when complexity is the problem itself, we pretend it isn't important and banish it from consciousness.

But the tendency of the mind to work this way does not need to be imposed upon the computer. In Virtually Reality 2.0, the ability to reconfigure the baseline of virtual reality means we need not be shackled by the limitations of mind or language. Nor do our theories have to reflect them. We can discover things about complexity, because we have the tool to explore. 'Flexible agency' means that our assumptions about human behaviour can be more realistic and our exploration of its implications be far reaching. Our economic theories turn out to be a small island, bounded by an illimitable ocean of possibility.

¹¹ Without it, there can be no priests, philosophers or administrators.