Letting Go : Chaos theory and the management of organisations

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“This organisation runs like clockwork; it’s always going round in circles”

In our attempts to understand how to manage organisations, we are often more affected by scientific thinking than we realise. The idea of the world as a great machine, operating in an orderly fashion according to it’s maker’s instructions, leads us easily to the idea that the best human organisations also operate in the same manner. Organisations will run smoothly, we assume, if each part is in its correct place, operating to its optimum efficiency, well oiled and ticking over nicely.

The scientific paradigm created by Newton and Descartes told us that the natural state for any system is equilibrium. Any departures from this would be damped out. If you try to interrupt a pendulum swing by giving it a push, it will soon revert to its natural rhythm. We also learned that the best way to understand any system was to look for cause and effect, and to reduce it to its component parts (which is why now have huge particle accelerators looking for ever smaller particles in the hope that this will tell us how the world works).

Management theory in the early twentieth century took the principles of equilibrium, reductionism and cause and effect for granted. Henry Ford is credited with applying them very successfully to the manufacture of cars. Management theorists used the metaphor of “organisation as machine” to develop control systems of planning, budgeting and management-by-objectives. Division of labour, interchangeability of parts, standard procedures and quality control are all the fruit of the scientific rational approach to management, and it has delivered some very good results. As Chinese writer Lin Yutang wrote in 1938, “I always rely on American water taps, rather than on those made in China, because American water taps do not leak”.

There’s a joke that illustrates this way of thinking. A vicar is walking through his parish, and stops to chat to one of his parishioners who is working in his garden. The garden is a masterpiece, obviously the result of many years of hard work and loving care. “Ah”, say the vicar, “it’s amazing what can be achieved when God and man work together in harmony”. “That’s right”, replied the gardener. “You should have seen the mess this garden was in when God looked after it all by himself”.

Slightly less funny is the world envisaged by writer Aldous Huxley in his 1932 novel “Brave New World”. The novel is set in the year 632 AF (After Ford), in a world in which all of humanity has been engineered into different social classes, ranging from the elite Alpha-Plus to the semi-moronic Epsilon-Minus. All of society’s activities are directed towards the maintainance of stability and equilibrium. As World Controller Mustapha Mond puts it in the book, “We have our stability to think of. We don’t want to change. Every change is a menace to stability”[1].

The problem is, the real world isn’t like a carefully-tended garden or a well-maintained machine. It is messy, turbulent and chaotic. We can’t predict the weather a week ahead. Rainforests are incredible systems of complexity that allow life to thrive in far greater abundance and diversity than any carefully-tended garden. As James Gleick puts it, we see “pattern born amid formlessness : that is biology’s beauty and its basic mystery. Life sucks order from a sea of disorder”[2]. Arthur Battram describes the “real world” as the place where ordered systems do not collapse into chaos if left alone, and biological metaphors, not machine metaphors, are the starting point for engaging with the real world[3].

Chaos theory[4] was developed first in mathematics, physics and biology in an attempt to understand and explain the patterns of order and disorder that we encounter in the world.

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[1] Aldous Huxley, *Brave New World*, London:Flamingo, 1994, p205
[2] James Gleick, *Chaos*, London:Vintage, 1998, p299
[3] Arthur Battram, *Navigating Complexity*, London : The Industrial Society, 1999, vi
[4] Sometimes called complexity theory, or dynamical systems theory

People familiar with Newton's Second Law of Thermodynamics, and the law of entropy, can sometimes struggle with the concept of chaos. The principle that everything tends towards disorder is firmly established in nonscientific culture, and feels intuitively right (have you looked in your child's bedroom lately?). In thermodynamics, this is a rule that is always true, but it has taken on a life far removed from its oringinal context. Entropy, or the tendency towards disorder, has been blamed for the disintegration of society and family life, and reflects the fascist/communist illusion that 'the people' need strong leaders to impose order to protect them from themselves. But in our world, both in nature and in human behaviour, chaos/complexity flourishes. Self-organisation is the norm. Natures forms patterns.

What I hope to do in this short paper is to identify the main elements of chaos theory, and to consider how they apply to human behaviour, so that we can draw out lessons for the management of organisations that reflect the "real world" of complexity and chaos, not the ideal (and terrifying) one of complete order and social control.

Stable chaos

Chaos theory is based on the recognition that real world systems never settle down into a steady state. The Newtonian goal of equilibrium is a fallacy. The weather never settles down into steady, cyclical patterns. Animal populations fluctuate constantly. All systems go through continual patterns of order and disorder, always changing, never repeating. And yet this is not simple disorder, utter chaos with no pattern whatever. 'Chaos' in its technical meaning exhibits a kind of stability within instability.

In 1960, meteorologist Edward Lorenz, one of the first scientists to explore the emergence of patterns in chaos, found that complex systems "stayed within certain bounds, never 'running off the page' but never repeating either". His findings "signalled pure disorder, since no point or patterns of points ever recurred. Yet it also signalled a new kind of order"[5]. Mathematician Stephen Smale, working at around the same time, noted that chaos and instability were not the same things at all. Chaotic systems could be stable, with their own particular brand of irregularity persisting in the face of small disturbances. Just as a regular pendulum returns to its ordered beat after being given an extra push, so 'chaotic' patterns of behaviour returned to 'normal' after being interrupted.

Philip Marcus, a NASA astronomer, did some computer modelling of Jupiter's Red Spot in the early 1980s using Edward Lorenz's work, and noted "you see this large-scale spot, happy as a clam amid the small-scale chaotic flow. The spot is a self-organising system, created and regulated by the same nonlinear twists that create the unpredictable turmoil around it. It is stable chaos"[1].

Strange attractors – the channelling and constraining of disorder

So where does this self-generated order come from? How does disorder get channeled or constrained to develop its own oder, without any kind of imposition from outside? In chaos theory, disorder turns into chaos because of 'strange attractors'. All systems have attractors – the attractor for a swinging pendulum is the point at which is hangs down, completely still, with no motion. This is the point toward which the system is moving, and at which, if no additional external force is applied, it will eventually arrive. Strange attractors are similar and different – they constrain unstable behaviour within certain limits.

Strange attractors are characterised by two features – they are stable (they represent the final state of any dynamical system in a noisy world), and they are non-periodic (they never repeat themselves, and don't fall into any kind of steady grandfather-clock type equilibrium). Otto Rössler commented that "nature does something against its own will, and produces beauty".

[5] Gleick, *ibid*, p30

Through strange attractors, nature is constrained. Disorder is channeled into patterns which, while never self-repeating, represent some underlying theme.

We need to think of strange attractors as more like a boat drifting in a slow current on a wide river, rather than a magnet drawing iron filings towards itself. The source of the pattern is not easy to discern, but it is clearly evident in its results.

> *Strange attractors in organisations include the values, goals and leadership styles adopted. Sometimes other attractors, such as informal leadership provided by someone who does not have any such formal role, can override and out-influence the formal attractors, both in positive and negative ways. We need to learn to look for the strange attractors at work in our organisations, recognising that they will often be hard to isolate but have a real influence nonetheless.*
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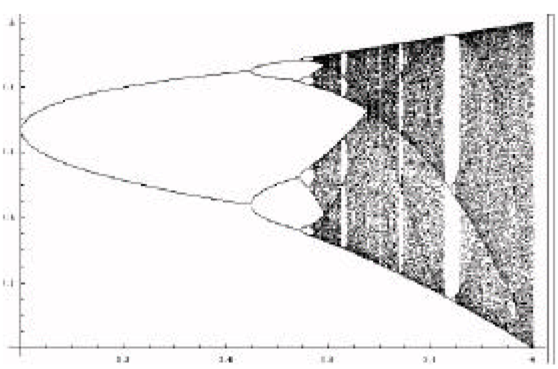
> *Similarly, the role of managers should not be to direct, but to function as the team attractor, setting the 'rules' or conditions that allow the appropriate behaviours and outcomes to emerge. This would offer a real world example of self-organisation, providing the opportunity for an open and adaptable form of teamwork, where people manage themselves within clear boundaries or according to clear terms or attractors.*

<u>Bifurcations – stability and instability</u>

In the 1970s, ecologists began to see patterns that other scientists had not been able to. They used mathematical models to track and predict the ebb and flow of population in different species, but they were aware that the models were poor approximations of the seething mass of real life. Their awareness of these limitations predisposed them to see the importance of irregularities that others saw as mere oddities. So while initial assumptions that populations were aiming for some kind of equilibrium level meant that, if numbers bounced back and forth, it was assumed that the population level was oscillating around some underlying equilibrium, people soon began to think that there might be no underlying equilibrium.

In both models and in reality, species populations were found to cycle between 'boom' and 'bust' over different periods, sometimes without pattern, and sometimes with new patterns of 'boom and bust' emerging. Similarly, it was well known that epidemics tended to come in cycles, and while intuition suggests that a programme of inoculation would change the pattern of infection in the desired direction (downwards), reality showed that huge oscillations were just as likely to be the result. The long-term trend for infection might be downwards, but it would be interrupted by surprising peaks. This was exactly the experience during the inoculation campaign to wipe out rubella in Britain.

So what was happening here? Where does this 'boom and bust' cycle come from, and should some interventions designed to move a pattern in one direction sometimes lead to contradictory outcomes?



The above diagram shows a classic birfucating image of chaos, where outcomes oscillate between widely-varying values, and then dissolve into disorder, which in itself contains both instability and pattern. It has been shown that many chaotic systems behave in such ways, and that the outcomes of actions in such a system cannot be predicted.

What does this mean for organisational behaviour? It basically means that if you want to predict and plan for the outcomes of any given action, forget it. Any dynamic, complex or chaotic system has so many factors bearing upon it, all of which react to one another's actions in an ongoing iterative process, that all outcomes will be 'chaotic', that is, will include elements of stability and instability. Enjoy the ride.

The butterfly effect

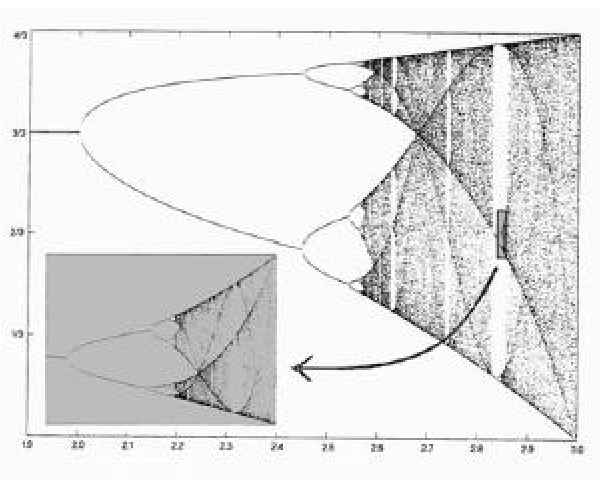
One of the other key features of chaos theory is the 'butterfly effect', and this links closely to the above concept of bifurcation, i.e. that it is impossible to predict the outcomes of any given action. The butterfly effect, or to give its technical name, "sensitive dependence on initial conditions", implies that outcomes can vary significantly with just a small variation in the initial inputs. This is embodied in the idea that a butterfly can flutter its wings in China, and two months later you get a tornado over the USA.

In organisational terms, this means that small actions can have big outcomes. In any non-linear, chaotic system, effects do not vary smoothly with input.

In such contexts, change is best seen as an iterative process of small steps, not (for example) the marshalling of large scale change 'muscle' to overcome the inertia of organisational culture. It isn't a case that small changes come from small actions, and large changes need large actions and major leverage. Who knows what small seeds we sow in people's minds that will bear considerable (and unforeseen) fruit in the future?

Since the setting of initial conditions is so significant in terms of final outcome, it highlights this as a key aspect of the leadership or management role. But be aware that the outcomes could vary considerably from what you anticipated.

Fractals – self-similarity across scale



Take a closer look at the above diagram. It shows the bifurcations mentioned earlier. Then note the highlighted area. When magnified, it shows that the pattern is repeated (albeit inversely) at a far smaller scale.

This is know as 'self-similarity across scale', or as fractal behaviour. The patterns exhibited by a chaotic system are the same at a macro and a micro level. IBM mathematician Benoit Mandelbrot, who coined the term 'fractal', first identified this behaviour when analysing the fluctuations in the price of cotton in the USA over the course of a century. He was trying to find the broad swings in the price of cotton, those that were unaffected by daily fluctuations and speculation, which were just 'noise', unpredictable and uninteresting. To his surprise, he found that while price changes were random and unpredictable, the curves for daily price changes matched those of monthly price changes exactly, The degree of variation in prices remained constant even during the first 60 years of the twentieth century, which included two world wars and a major depression.

Fractals belong to chaos theory because they represent the emergence of order and beauty in chaotic systems. "In the end, the word *fractal* came to stand for a way of describing, calculating, and thinking about shapes that are irregular and fragmented, jagged and broken-up – shapes from the crystalline curves of snowflakes to the discontinuous dusts of galaxies. A fractal curve implies an organising structure that lies hidden among the hideous complication of such shapes"[6]. They also show that chaotic systems develop similar patterns of order at different scales.

> *Applying fractal thinking to organisations is potentially fruitful in helping to think about how they should be structured, and also for analysing organisation-wide behaviour by identifying the self-similar patterns that exist at lower levels or at a smaller scale.*
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> *The following comment illustrates this approach : "We have found success in using the tools of family therapy in larger systems by helping groups turn their attention to the way their system functions—to basic processes. We have often found that the problems in the group are structurally similar to problems in the external environment or a larger system of which the group is a part, but they occur a smaller scale. They are fractals. In mathematics, a fractal is an intricate design that appears when a series of nonlinear equations are solved by a computer and the results are repeatedly fed back into the equations. The design that results from this iterative process is composed of parts that are self-similar on different scales. In some fractals, you will see the same pattern when looking at the initial design as you will when you magnify a portion of it 200 times, or a million times, or a billion times. It is an expression of self-similarity across scales. Fractals are one way in which nature organizes itself, and, therefore, it is not surprising that human problems can also express this type of self-similarity across scales"[7].*

An unapologetic footnote

If this short paper seems rather abstract and theoretical, it is because it is intentionally so. I have tried to give some pointers to where I think chaos theory can be applied to organisational behaviour, but I do so in much more practical detail in my book *World of Difference*. But, to keep the book a bit more readable, I used some of the concepts and assumptions of chaos/complexity theory to explore how organisations might behave in an increasingly complex and diverse world, without necessarily spelling out the theoretical basis of the ideas. I have found that people misunderstand what is meant by *chaos*, and that is why I have put together this short paper. Perhaps the most important principle to remember about chaos theory is that of 'self-organisation'. Now go read my book[8].

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[6] Gleick, *ibid*, p114
[7] Judy Kirmmse and Jo Vanderkloot, http://www.afta.org/newsletter/83/kirmmse.html (accessed 15th December 2003)
[8] Copies of *World of Difference* can be ordered from
http://www.paternoster-publishing.com/Merchandiser/catalog/Product.jhtml?PRODID=225181&CATID=77
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