**“Towards a Complex Conception of Progress”**

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**Bio**

Craig Lundy is a Reader in Social and Political Thought at London Metropolitan University. The majority of his research has been concerned with exploring the nature of transformational processes, in particular the role that history plays in shaping socio-political formations. Much of this research has focused on the work of Gilles Deleuze and the post-Kantian lineage (e.g. Hegel, Marx, Nietzsche, Bergson), however he has also conducted applied research using the principles of complexity theory/science to examine a range of issues including the formation of community identity, the pedagogy of ‘service-learning’ and the processes of public engagement. Craig is the author of *Deleuze’s Bergsonism*, *History and Becoming: Deleuze’s Philosophy of Creativity*, and he co-edited with Daniela Voss the collection *At the Edges of Thought: Deleuze and Post-Kantian Philosophy*, all published by Edinburgh University Press.

**Abstract**

For many decades, scholars working within the broad paradigm of complexity studies/theory have explored the nonlinear dynamics that contour physical and social systems. In doing so, radical theories that contest both Newtonian and neo-Darwinian understandings of reality have been posited, augmenting how we think about processes of change. But throughout these developments, the modern idea of progress has arguably remained insufficiently contested. This paper seeks to show how the framework of complexity can offer conceptual resources for rethinking progress. Key characteristics of complexity are articulated and critically examined with the aim of pinpointing how they might contribute to a conception of progress that is worthy of the name yet divergent from its dominant ‘modern’ form.

**Keywords**

progress, complexity, nonlinear, emergence, attractors, path-dependence, open, contingency

**Introduction**

The world of quantum physics is full of wacky and wonderful theories: ‘Schrödinger’s cat’, ‘Wigner’s friend’ and ‘the uncertainty principle’ are just some of the infamous experiments and ideas that challenge common sense notions of causation, stretching the limits of credulity. But despite successes in shaking-up the classical framework of physics, how many quantum scholars *live their lives* according to these findings? How many have changed the way that they view the course of human history, the narrative of their career, or their plans for the future due to the revelations of quantum physics? I would hazard to say not many. When it comes to the way that human beings project into the future and reflect on the journey of their lives and society, conventional ‘common sense’ notions of cause/effect and the mantra of progress still reign supreme. But what if we were to allow developments in contemporary science about the nature of change and causation to influence our understanding of human affairs, and in particular the manner of their transformation over time? Throughout history many of the great explanations of human society and its vicissitudes have been wedded to and/or inspired by theories of the physical cosmos. It would appear, though, that the notion of progress bequeathed by modernity remains largely intact despite major shifts in scientific understanding since the Enlightenment. Could a reappraisal of progress in light of these developments lead to a more widespread alteration in how this idea is viewed and used?

For the past several decades there have been some attempts to do just this in the field of ‘complexity studies’. Drawing on findings in biology, physics and mathematics that contest the orthodoxies of Newtonian and Darwinian science, scholars in the humanities and social sciences have explored how these ‘complex’ and ‘nonlinear’ alternatives can inform our appreciation of social and social-physical systems. Insofar as the ‘complexity’ paradigm provides an alternative way of thinking about and understanding processes of change, one would assume that these implications would -or at least could- extend to the framework of ‘progress’ that underlies much human sense-making. Efforts to explicitly articulate what a properly complex conception of progress might look like, however, have been arguably underdone. This essay aims to address the lacuna by exploring how progress might be reconceived according to key principles and findings of complexity theory. The purpose of doing this will not be to convince the reader that a complex conception of progress is ‘correct’ or ‘true’, with other conceptions ‘incorrect’ or ‘false’; my intention is to merely explore how the complexity paradigm can contribute to challenging and evading the conventional understanding of progress and progression. Complexity theory no doubt has its own flaws and weaknesses, some of which I will touch on, but it would still seem to me that there is mileage to be gained from mining the resources of complexity in order to gesture towards a new notion of progress that goes beyond its modern form, simultaneously sidestepping the interminable critique and defence of this modern idea.

The focus for much of this essay will be on processual aspects of progress in a technical sense, such as ‘nonlinear’ trajectories of change, the dynamics of ‘emergence’ and the nature of ‘attractors’. As a consequence, the ethical dimensions of progress will be downplayed in favour of examining the relation of elements in a system and/or series. Like many scientific theories of nature, complexity theory is often presented in an a-ethical fashion – the dynamics and principles are neither ‘good’ nor ‘bad’, they simply are.[[1]](#footnote-1) Although this position is naïve, since all scientific theories are based on and sometimes produce their own cultural myths, it would seem to me that complexity theory has the capacity to give us a way of thinking about progress and progression that diverges from the modern ethic of ‘betterment’. Rephrasing this suggestion in the form of an open question: to the extent that complexity theory offers a cosmology detached from the classical Newtonian and Darwinian frameworks, which are themselves shot through with the modern idea of progress and its ethic of betterment, what ramifications might this alternative have for reconfiguring progress? I will speak to this question after outlining the nonlinear, emergent, attracted and path-dependent characteristics of complex progress.

**Nonlinear Progress**

The ‘modern’ idea of progress is often characterised as giving a ‘linear’ account of history, in which progress proceeds in a line – more specifically, a ‘straight’ line, heading ‘upwards’, which is to say in the direction of ‘betterment’. Seen this way, progress is a linear sequence of gradual unerring betterment, the diagonal line heading from bottom left to top right. It is important to note, however, that the ‘modern’ idea of progress need not be understood as linear. To take one paradigmatic case, Sofie Møller (2021) has argued that Kant’s philosophy of progress, contrary to conventional wisdom (Allen 2016: 8, Koselleck 2002: 227), is built on a notion of *nonlinear* progress. According to Møller, progress for Kant refers to the “way in which humanity […] reaches its full potential” (2021: 130-131). This journey, though, is by no means smooth: periods of progress are followed by regression, after which a leftover “germ of enlightenment” is taken up, facilitating the next “stage of improvement” (Kant 1995: 8:30). Insofar as Kant’s position allows for periods of regression, and as such departs from the ‘linear’ account described above, it is understandable why Møller describes Kant’s philosophy of progress as ‘nonlinear’. But this raises the question: does anyone *really* believe in a vision of historical progress that is entirely devoid of any deviations or periods of stagnation whatsoever? I suspect that even evangelists of progress would baulk at this ‘straw man’ figure, and in fact Møller’s own definition of linear progress allows for ‘minor setbacks’ (2021: 128). Seen from this perspective, practically every account of progress is a nonlinear account. If the terms linear/nonlinear are to have any meaning, therefore, it would seem that they must refer to more than the mere existence of regression or unevenness. Kant’s philosophy of progress, to be sure, is not nonlinear simply because there are periods of regression; more significantly, it is because these regressions are a “contingent occurrence” (Kant 1995: 7:88). From this we can see that nonlinearity refers not merely to the fact that regressions occur, but furthermore that they are contingent and unpredictable. To borrow an example from sports, some defeats are occasionally characterised as ‘good’ or ‘productive’ if they spark a reaction that leads to victory. However, what makes this journey nonlinear is not simply that such defeats/reactions happen, but that they cannot be predicted in advance and could have happened differently or not at all. At this point it is customary for analysis to move on to an investigation of what ‘causes’ this line to meander and whether we can ‘know’ its direction in advance. But before we jump to these questions, let us turn to complexity theory to see how nonlinearity is defined there.

Nonlinearity is a key feature of complex systems, referred to in practically all of the literature in this field. Whilst there are some recurring descriptions of nonlinearity amongst this literature, there is also no small amount of discrepancy. According to most experts, the term ‘nonlinearity’ refers first and foremost to *relational proportionality*, or more exactly the lack of it (Durie and Wyatt 2007: 1930-1931). At a technical (mathematical) level, a nonlinear system does not satisfy the ‘superposition principle’, where f (x + y) = f (x) + f (y). Re-worded in prose:

[In a linear system] the sum of two solutions is again a solution, which makes linear equations relatively easy to solve. They are called ‘linear’ because they can be represented on a graph by a straight line. Nonlinear equations, by contrast, are represented by graphs that are curved, are very difficult to solve, and display a host of unusual properties. (Capra 2005: 35)

Astill and Cairney make the point in slightly different language, stating that linearity is where “the change in the dependent variable is always the same amount for any given amount of change in the independent variable” (2015: 133). Nonlinearity, on the other hand, is where “small changes may lead to large consequences”, and vice versa (DeLanda 2002: 52; see also Preiser 2019: 708-711; Walby 2003: 12; Walby 2007: 455-6 and 464-5).[[2]](#footnote-2) This characteristic has been commonly referred to as the ‘butterfly effect’, where the flap of a butterfly’s wings in one part of the world leads to a tornado in another part of the world. However, if this example is significant, it is not only due to the illustration of disproportionality. More profoundly, the causal chain between the butterfly and the tornado cannot be reliably predicted.

This difficultly of prediction and modelling, it should be said, does not apply to all nonlinear relationships, some of which can be easily ‘transformed’ or disaggregated into linear relationships. In fact, a significant section of complexity scientists/mathematicians specialise in ‘solving’ difficult nonlinear equations by replacing them with a number of smaller linear approximations (Capra 2005: 35, see also Gare 2000: 329-340). The advent of high-powered computers has made this line of work much more successful than previously imagined, but several complexity scholars argue that there remains a qualitative difference between ‘complicated’ problems/systems, which may be ‘big’ but can be broken down into numerous ‘small’ ‘non-complicated’ problems/systems, and properly ‘complex’ problems/systems that cannot be ‘linearised’ in the same fashion. For such scholars, there is an irreducible uncertainty inherent in complex systems, regardless of the prevailing capacity for calculation (Thrift, 1999; Kernick 2006). Again in the words of Astill and Cairney: “The very essence of the ‘butterfly effect’ of complex systems and non-linearity is that, as we vary some independent variable(s) consistently, we cannot hope to find a recognizable, or even necessarily repeatable, pattern emerging in the dependent variable that we can express in any reductive way” (2015: 135). In this respect, the disproportional nature of nonlinear relationships is of less importance than the claim that such disproportionality is difficult if not impossible to map into the future (Astill and Cairney 2015: 132-135; Cilliers 2005: 258; Clark 2005: 173; Durie and Wyatt 2007: 1931; Eppel and Rhodes 2018: 949-950). If small changes *may* lead to large consequences in a nonlinear system, why does this happen only sometimes, and why can’t we predict when it will? We thus return to the task of explaining why the nonlinear line meanders, and in an unpredictable way.

Some complexity scholars have suggested that the uncertainty is a result of the ‘high connectivity’ in a nonlinear system (van Uden et al 2001), or what Clark calls “the density of interconnections and the multitude of possible combinations” (2000; see also DeLanda 1997: 109 and 273). Such responses, however, seem inadequate, for they imply that the impasse could be merely due to the present limits of our computational power. If we presume that nonlinear systems are fundamentally irreducible – i.e. cannot be fully predicted in principle, not simply because they are ‘really complicated’ and beyond our current computational means – it would appear that some other explanation for this is needed.

A common candidate for this within the complexity literature is ‘feedback loops’, of which there are two kinds: *negative* feedback loops that ‘dampen’ the propensity for change and maintain the status quo of a system, and *positive* feedback loops that ‘amplify’ perturbations leading to systemic change (Preiser 2019: 711; Kernick 2006: 386; Richardson et al 2001: 7). Once again, though, it is not entirely clear how feedback loops render a nonlinear system unpredictable. Presumably it is because these feedback loops are themselves unpredictable, as a result of “small random events” that “happen” (Arthur 1999: 107-9), but what makes them random, and what makes them happen or not happen? Even more worryingly, feedback loops are often pointed to as a self-evident illustration of nonlinearity, but what about them is actually nonlinear? Consider DeLanda’s example of a (negative) feedback loop: the regulating thermostat. DeLanda says that when the effector (heating-cooling element) changes the room temperature “it thereby affects the subsequent behavior of the sensor” (1997: 67). From this he concludes that “the causal relation does not form a straight arrow but folds back on itself, forming a closed loop” (1997: 67). This loop, “in which the effects react back on their causes” (DeLanda 1999: 9), is furthermore said to be an example of ‘circular causality’ (1997: 67) and ‘reverse causality’ (1997: 293). From this description we can see why feedback loops would be associated with nonlinearity as opposed to linearity (see also DeLanda 1997: 55 and DeLanda 2002: 53). On closer inspection, however, the characterisation of these relations as a ‘loop’ is little more than a play on words. This is because the events must surely occur *in time*, which continues to unfold asymmetrically and does not repeat or go backwards. When the sensor tells the heating-cooling element to turn on for the second time, it does so for a second time, not the first or the third. There may be resemblance between iterations, but history does not *actually* repeat itself. The history of the First and Second World War, for example, might be said to involve a ‘back and forth’ set of reactions between the protagonists, but this does not mean it can’t be explained by conventional causal-linear mechanisms. If you say something to me and my response to you influences what you next say to me, this is hardly an example of reverse causality that undermines the classical understanding of cause and effect; far from being a radical paradigm-shattering illustration of causality, this ‘back and forth’ exchange or so-called ‘loop’ could hardly be more ordinary.[[3]](#footnote-3)

The nonlinearity of feedback loops is thus only achieved by placing them *outside of time* – it relies upon the abstraction of a temporal series into a spatial loop. Or in the words of Smith and Jenks (2005: 152): “‘recursive causality’ – a characteristic of complexity, implied in ‘bringing forth worlds’ – still has a temporal direction, which makes that particular expression questionable”. If feedback loops are not even suitable for explaining nonlinearity, there is little hope that they will be able to explain the unpredictability of nonlinear systems for us. We should not be surprised by this, for if Ilya Prigogine has taught us nothing else about complex systems it is that they are composed of *irreversible processes*.[[4]](#footnote-4) And herein lies the clue to explaining the unpredictability of nonlinear progressions: to say that nothing truly repeats itself is to say that reality is continually being created, becoming. If the future is unpredictable, this is because it is not entirely reducible to the present or past. Nonlinearity may be suitable for describing the disproportionality of progressions, but it would appear that it does not provide a sufficient reason for the uncertainty and unpredictability of complex progressions. For that we will need to turn to another key principle of complexity theory: *emergence*.

**Emergent Progress**

As we have now seen, the distinction between linear and nonlinear progressions could refer to the quality of the line that is unfolding – i.e. its directionality or disproportionality – but regardless of this distinction the more significant consideration is whether the progression is contingent or necessary, predictable or unpredictable. To illustrate the point, most scholars who speak about nonlinear processes do so in order to indicate the element of randomness or uncertainty, they do not have in mind those nonlinear equations that can be completely reduced to determinant linear subsets. By the same token, linearity for these scholars refers to a set of relations characterised by necessity, uni-directionality, direct proportionality and uniqueness (where the same cause always leads to the same effect (DeLanda 2002: 138-9)). Although it is doubtful whether anyone actually believes that this strict definition of linearity is an accurate description of reality, especially in the realm of human affairs, the purpose of the straight line motif is to counterpose a vision of progression devoid of uncertainty in every respect – a far-fetched vision, which emphasises and advocates the contingency of its nonlinear alternative.

At this point it is worth reflecting on another giant of modernity that is frequently associated with the European philosophy of progress, Hegel. In recent years there has been an attempt to recuperate Hegel’s reputation when it comes to his theory of world history and the progress it entails. In contrast to the portrayal of Hegel’s philosophy of history as a form of historicism that universalises history by virtue of a unitary and totalising force, some have argued that creativity and contingency lies at the core of his vision. As we already saw with Kant, for Hegel the progression of history is far from smooth and measured; instead, history proceeds by way of struggle and contradiction, with progressions resulting from various contingent circumstances and unpredictable events. Indeed, this is what history is: the progress from one level of freedom and self-consciousness to the next that is instigated by the dialectical resolution of contingent occurrences. Contingency, in this respect, is *required* for historical progress to occur (see Macdonald 2006; de Boer 2009; Maker 2009). So what we have here is a theory of how new social formations emerge, one of the most influential theories of emergence ever articulated, which features contingency prominently. All this said, it must be remembered that Hegel’s aim is not to celebrate the contingent and insist on its irreducibility. Far from it:

The sole aim of philosophical enquiry is to eliminate the contingent. Contingency is the same as external necessity, that is, a necessity which originates in causes which are themselves no more than external circumstances. In history, we must look for a general design, the ultimate end of the world, and not a particular end of the subjective spirit or mind; and we must comprehend it by means of reason, which cannot concern itself with particular or finite ends, but only with the absolute. (Hegel 1975: 28)

Thus while there may be ‘set backs’, ‘accidents’ and ‘unexpected events’ in history, these are all retrospectively understood and determined via the dialectic of reason, which ultimately moves in the direction of becoming progressively ‘free’ and self-determining. Contingency is ultimately reducible to a necessity-making-mechanism that functions according to the principles of dialectics (contradiction/antagonism) – e.g. *x*and *y*are contingent or accidental *with respect to the totalising power that makes them so* – a power and process that is by no means random and devoid of direction, even if this is only retrospectively revealed. Hence the significance of the retrospectivity at the heart of Hegelian historicism, which orders externalities according to an internal(ising) mechanism. Malabou and Zizek are right to focus on this aspect of retrospection (see Clark and Szersynski 2022), but who or what is it that retrospectively projects, and how? All roads lead back to Geist and the dialectical mechanism of contradiction/antagonism. This mechanism may be thought of as creative or productive in a certain sense, but as pointed out by Deleuze, this sense is more exactly *creation by negation* (Deleuze 1983: 8-10). The mechanism might also rely on difference and in a certain sense produce it, but it is a difference reducible to the identity of Geist (even if this identity is never ‘finished’/fully understood and we never actually reach the ‘end of history’).[[5]](#footnote-5)

What, then, would a theory of emergent progression look like that is worthy of the name? Let us consider the example from complexity theory. Like nonlinearity, emergence is a touchstone term of complexity scholarship that is frequently referred to but often left unexplained. At its most basic, a phenomenon is said to *emerge* from an interaction of elements. In its more prosaic formulation, emergence is regularly used in complexity scholarship to refer to the emergence of ‘order out of chaos’ (Prigogine and Stengers 2017), or using slightly different language, the emergence of new ‘patterns’ (Urry 2005: 239). Walby prefers to conceive of this using the terminology of ‘levels’, in which each level has a different pattern and “one level is emergent from other” (Walby 2007: 460, 463; see also Walby 2003: 2, 4, 10-11). But far more common amongst the literature is a discussion of how a large number of small interactions, acting/reacting in response to ‘local stimuli’, produces a collective order (Trenholm 2013). The pattern or order of flocking birds, for example, is said to emerge from three rules: maintaining a minimum distance from objects, matching one’s speed with adjacent birds, and moving towards the perceived centre. As another example, Goodwin explains how when the density of an ant colony reaches a ‘critical value’, there is a transition from a ‘chaotic pattern’ to a ‘dynamic order’: “The group behaves in a collective mode that could not be predicted from the behaviour of individuals”, which Goodwin takes to be “a clear example of emergent behaviour” (Goodwin 1994: 65-66). As these examples suggest, a crucial feature of emergence in complexity theory is that the emergent order does not reside ‘in’ the individual components, but *between* them. In the words of Human, the emergent phenomena “cannot be found inside the individual properties of the components but is a result of their interaction” (Human 2016: 428).[[6]](#footnote-6) The examples also do a good job at indicating how order and chaos are not dialectically opposed or antagonistic, but are instead part of the same continuum or spectrum. Prigogine’s work on ‘dissipative structures’ can help us here. Similar to Goodwin’s ant colonies, Prigogine’s research shows that an increase in the flow of energy in a system can lead to a point of instability that results in the emergence of new structures and forms of order (Capra 2005: 37). The increase in energy flow is said to push the system ‘far from equilibrium’ or ‘to the edge of chaos’, and in order to “‘cope’ with the excess energy better” the system re-organises itself (Smith and Jenks 2005: 145) – a process referred to by others as adaptive self-organisation (Anderson 2005). As such, “life exists at the edge of chaos, moving from chaos into order and back again in a perpetual exploration of emergent order” (Goodwin 1994: 169).

We can already see some important distinctions between the complex version of emergence and that of Hegel – notably the absence of a dialectical mechanism and the preference for a more fluid continuum of change. What we haven’t yet been given, however, is an explanation of why the emergent patterns are qualitatively contingent, indeterminate and/or unpredictable. For instance, while it may be difficult for us humans with our limited brain-power and computing capacity to calculate all of the micro-interactions that occur in the flocking of birds, is this the reason why we can’t predict in advance the exact patterns that emerge, or is there some deeper ontological impediment?

There is no consensus on this amongst the complexity theory community – while some complexity scholars are preoccupied with reducing (if not eliminating) unpredictability for the purposes of modelling the future, others argue that the whole point of complexity thinking is to break free of the classical reductionist framework and liberate the future from certainty. Those in the latter camp invariably remark that complex systems are *open*, and it is this simple word that would appear to be doing much of the heavy lifting. The characteristic of emergence in complexity theory depends upon the existence of openness, otherwise that which emerged would have been foreclosed. As with nonlinearity, openness is conceptually defined by what it is not: closed. In a closed system all behaviour can be predicted from the outset, at least in principle. If complex systems retain a kernel of uncertainty or unpredictability, if they are ‘non-totalizable’ (Human and Cilliers 2013: 36), it is because the system is open to the outside, to external influences that precipitate the emergence of new patterns (Boulton, Allen and Bowman 2015). When a system is open in this manner, it becomes impossible to ‘know’ all of the elements at play. We cannot even be certain that the same input will have the same effect, since other changes in the surrounding context could influence the outcome (Cilliers 2000). It is the openness of complex systems, in other words, which affirms the basic insight that history never repeats itself.

But does the element of openness merely displace and not dissolve the promise of certainty? When we say that a system is open, are we not just saying that it is part of a larger system, which might itself be determined and predictable if one had the capacity? And to what extent are the demarcations of inside/outside arbitrary and relative to the projecting subject (Kernick 2006; Van Uden, Richardson and Cilliers 2001: 63; Cilliers 2005: 258)? It may be convenient for the sake of analysis to demarcate a system that can be grasped by the human mind and then add the addendum that the system is ‘open’ to the things that we left outside it in our act of demarcating, but is this anything more than an exercise in mental gymnastics? What do the birds care if we happen to ‘see’ a pattern in the outline shape they form when flying? In this respect, the characteristic of openness is itself a product of the determination of inside/outside – a determination that creates the system that can then be said to be open to things outside it. If a complex system is un-totalizable due to its ability to affect and be affected by the surrounding environment (Walton 2013), this may assure the complexity of one system, but this doesn’t explain why the universe as a totality is complex. Acknowledging this, however, does not make the activity meaningless. On the contrary, it emphases how demarcated systems are projected entities whose meaning is produced by and from the perspective of a subject. As stated by Deleuze: “The interior is only a selected interior, and the exterior, a projected interior” (Deleuze 1988: 125). We will return to this crucial point in the final section of the paper. For the moment, however, it should be noted that the activity of individuation being referred to here – the selection process in which a shape or order is carved out of chaos – is not a purely subjective determination, for even if everything is ultimately connected with everything this does not preclude the existence of corporeal subsets that have a certain systematicity or privileged set of relations. Hence Prigogine’s term ‘dissipative structures’: the physical phenomena being examined and described do indeed form a ‘structure’, albeit one that changes or dissipates over time through interactions both internal and external. The terminology of open/closed and inside/outside is therefore a subjective convenience, but it is not an arbitrary fantasy and it is employed for a good reason: to better understand and describe reality.

What, then, does all this mean for a complex conception of emergent progress? To remind, part of the reason we have gone to complexity theory is to see whether it has useful conceptual resources for taking us beyond the modern idea of progress and its conventional views on the nature of emergence such as we find in Kant, Hegel and related thinkers (e.g. Marx, Habermas). In particular, it was hoped that this complex theory of progress would provide a compelling alternative to those theories of emergence that are based on necessity. In the work of scientists such as Goodwin and Prigogine we can find revealing accounts of how new patterns emerge in the natural world, ‘order out of chaos’. Their theories are of *asymmetrical* or *irreversible* progressions, but they retain the characteristic of contingency by virtue of their openness. In one respect, the determination of open/closed and inside/outside of complex system could be said to depend on the perspective of the observer, but this hardly means that the behaviour of an ant colony or a dissipative structure will change if it is observed by a human subject (or not). Rather, it is the *description* of patterns that depends on the subject. In describing a sequence of systemic change, complexity theory provides an explanation of how new phenomena emerge through interactions in a ‘world of becoming’, to borrow Connolly’s phrase (2011). It would be misleading, however, to imply that complexity theory proposes a vision of the future as ‘radically open’, as if anything could happen and everything is equally likely. Similarly, coming from the other direction, it would be a mistake to presume that in complexity theory the past bears no impact on the present. Quite the opposite: emergent progress in complexity theory are both ‘path-dependent’ and influenced by ‘attractors’. In what respect, we might then ask, is the complex conception of progress different from the mechanistic and teleological accounts that it aims to distance itself from?

**Attracted and Path-dependent Progress**

In his book *Creative Evolution*, Henri Bergson criticises those accounts of evolution that fall foul of what he calls ‘radical mechanism’ or ‘radical finalism’. Describing the former he says:

The essence of mechanical explanation, in fact, is to regard the future and the past as calculable functions of the present, and thus to claim that *all is given*. On this hypothesis, past, present and future would be open at a glance to a super-human intellect capable of making the calculation. (Bergson 1998: 37)

As Bergson elaborates, the mechanistic vision of causation, in which nature is conceived as “an immense machine regulated by mathematical laws” (Bergson 1998: 45), overly valorises the past by suggesting that the coordinates of the present (and future) reside within it. Bergson does not deny that the past contours the present and future – indeed, his concepts of duration and memory are essentially an attempt to describe their continuity, as a ‘heterogeneous multiplicity’. But his point here is that if a new emergence is to be worthy of the name, then it must be more than a mere rearrangement of the old. According to Bergson, genuine emergence is an impossibility in radical mechanism, for it “implies a metaphysic in which the totality of the real is postulated complete in eternity” (Bergson 1998: 39).

Unlike radical mechanism, radical finalism does not rely on a ‘billiard balls’ vision of cause and effect; instead, it is a teleological doctrine that posits the programme to be realised. But as with radical mechanism, radical finalism operates by extrapolating from the known and the datum of the past forward into the future. For this reason Bergson says that radical finalism is nothing more than an inversion of radical mechanism: “it holds in front of us the light with which it claims to guide us, instead of putting it behind. It substitutes the attraction of the future for the impulsion of the past” (Bergson 1998: 39). It is important to note that Bergson is not against all theories of finalism – in fact, his theory about the individuation of the *élan vital* is itself a form of finalism, but as Deleuze summarises in his book on Bergson: “There is finality because life does not operate without directions; but there is no ‘goal’, because these directions do not pre-exist ready-made, and are themselves created ‘along with’ the act that runs through them” (Deleuze 1991: 106).

Complexity theory offers another way of navigating between radical mechanism and radical finalism, between determinism and teleology. Perhaps the most important accomplishment of complexity science has been its critique of the classical Newtonian framework – to bring about ‘the end of certainty’ (Prigogine 1997). As this phrase suggests, complexity liberates the future, but this does not mean that the future is a blank canvass. On the contrary, complexity theory has a lot to say about how processes unfold, influenced by so-called ‘attractors’. As Capra explains, when mathematicians ‘solve’ a nonlinear equation, “the result is not a formula but a visual shape, a pattern traced by the computer, known as an ‘attractor’” (Capra 2005: 35). The attractor is a representation of the system’s long-term dynamics. A nonlinear system can have several attractors (which is to say, multiple solutions). Depending on where a trajectory commences it will eventually gravitate towards the attractor that organises that particular region of the system, what is referred to as the ‘basin of attraction’. Drawing on the ontology of Deleuze, DeLanda describes the alternative states or basins of attraction as *virtually coexistent*. Although one attractor may be ‘actualised’ at a particular point in time, “All one has to do to reveal their virtual presence is to give a large enough shock to the system to push it out of one basin of attraction and into another” (DeLanda 2002: 66-67). From this description of attractors it is clear that the manner in which complex systems undergo change is not a free-for-all; phase spaces are each characterised by distinct dynamics, which are visually represented by the various attractor patterns. Being nothing more than visual representations, it would be wrong to say that the attractors themselves exude an active pulling power of the system towards it, like a magnet. But at a more general level it would also be a mistake to equate mathematics with reality. As Gare remarks: “Dynamical systems are not systems in the world but mathematical models of systems” (Gare 2000: 329). If there is one obvious difference between the two it is that the mathematical models are *of space* and exist *outside of real time*.

As it happens, Bergson’s critique of radical mechanism and radical finalism turns on just this point. If mechanistic explanations seem convincing, it is because they “hold good for the systems that our thought artificially detaches from the whole” (Bergson 1998: 37), systems that are “withdrawn, by hypothesis, from the action of real time” (Bergson 1998: 29). So too with radical finalism, in which “succession remains none the less a mere appearance, as indeed does movement itself” (Bergson 1998: 39). Complexity theory, it would seem, is well placed to avoid the trap of spatialising time, due to its emphasis on irreversible and asymmetrical temporal processes. As Prigogine and Stengers say, “reality is embedded in the flow of time” (2017: xxix). In this vein, complexity scholars often remark that in complex systems ‘history matters’. This phrase, however, could refer to several things. To start with, it could mean that unlike ‘ahistorical’ sciences that are devoid of temporality, complex systems each have a unique story. In the words of Clark, “each complex system acquires its own individual and singular history” (Clark 2005: 177), or as he says elsewhere, “[life] evolves through a succession of time-irreversible events which are in turn entwined in the no-less-irrevocable movements of the world around it, all the way up to the level of the universe” (Clark 2005: 165). This motif of nothing happening twice suggests that ‘history matters’ because it never repeats itself.

Distinct from but related to this point is a second sense in which the phrase is used, whereby ‘history matters’ because it informs what comes next. As a complex system undergoes change, it becomes faced with ‘bifurcation points’ where it must ‘choose’ between alternatives. The path chosen in turn has consequences for what happens next; or seen from the other end, outcomes are “subject to the historical path taken” (Arthur 1999). The development of the QWERTY typewriter keyboard is an oft-cited example of this, in which the initial path ‘chosen’ guides future developments (Waldrop 1993: 40).[[7]](#footnote-7) Such examples illustrate how complex systems are ‘path dependent’ and can experience ‘lock-in’, as the momentum of their trajectory influences the direction of their development. Using slightly different language, Richardson et al say that a complex system “has a memory” (2001: 7-8). But these sorts of statements lead us back to the delicate dance of necessity and contingency. On the one hand, the phrase ‘history matters’ is uttered to affirm contingency and reject the reduction of emergent progress to the mechanics of the past or the telos of the future. For Urry, the phrase ‘history matters’ means that “different paths could have been taken” (Urry 2005: 239); and for DeLanda, “with multiple possible outcomes *the details of the history followed matter*.” (DeLanda 2005: 83). But on the other hand, ‘history matters’ because it *constrains* emergence. History might not repeat itself, but it quite often *informs* what happens next. This is not to say that all paths are pre-determined, but neither are they entirely open. What complexity theory gives us is a way of understanding how the dynamics of a system guides and constrains the nature of its development, from both a spatial perspective (i.e. basins of attraction) and temporal (i.e. its history), whilst retaining an element of contingency and indetermination.

Although this process differs fundamentally from the Newtonian framework and the modern idea of progress, it is nonetheless a form of development that clearly involves *progression*. One moment does not simply come after the next, each one *builds* on the last. As Bergson says of duration, it “is the continuous progress of the past which gnaws into the future and which swells as it advances” (Bergson 1998: 4). And again: “Real duration is that duration which gnaws on things, and leaves on them the mark of its tooth” (Bergson 1998: 46). The process of change described by complexity could be said to similarly constitute an ‘advance’, insofar as it involves an incessant moving forward – there is no going back, because time is irreversible. This is why the word ‘history’ is completely appropriate: what we are dealing with here is not time in the abstract, but *real duration*, which bites and bleeds and scars. This is also why ‘history matters’ in complexity, in a way that it doesn’t in deterministic and teleological accounts of progress. But most importantly, the advance of complexity is not one of ‘betterment’. Unlike Darwinian and neo-Darwinian renditions of evolution, the process of development described by complexity does not necessarily involve an underlying sense of ‘improvement’ or ‘better fit’. Indeed, some complexity biologists, such as Brian Goodwin, claim that one of the best things about complexity is its ability to evade the Christian ethic of striving and betterment that is endemic in much evolutionary theory (Goodwin 1994: 28-32). As he demonstrates by outlining key developments in Darwin’s theory and comparing the Darwinian principles of evolution with the central ethical tenets of Christianity, Darwinism “has its metaphorical roots in one of our deepest cultural myths, the story of the fall and redemption of humanity” (1994: 30). Darwin no doubt commits heresy, by toppling God from His position, but the story, for the most part, “remained much the same as before in terms of competition, struggle, work and progress” (1994: 30). There have been no shortage of attempts to distance the Great Man and his ‘dangerous idea’ from the more unpalatable instances of ‘social Darwinism’, but as Goodwin points out, Darwin was an adherent to the myth of progress and its underlying ethic of betterment, and this myth most certainly informed his theory of evolution and his view of humanity.[[8]](#footnote-8) It would appear that complexity does not participate in perpetuating this myth of progress; or perhaps more modestly, it would appear that inasmuch as complexity offers a way of understanding processes of change that departs from the Newtonian and Darwinian frameworks, it potentially gives us a way of conceiving progression without the baggage that the modern version of this idea lugs around. All that being said, it must be admitted, as Goodwin does, that complexity theory is also riddled with anthropomorphism and the overlaying of cultural predilections on natural phenomena – a characteristic it shares will with all other theories of naturalism. What, then, is its worth?

**Conceptualising Progress with Complexity**

The conception of progress is to a large degree an epistemological concern, a matter of perspective. As Frantz Fanon would say, what the colonisers call progress and Enlightenment goes by other names according to the colonised, such as oppression and injustice.[[9]](#footnote-9) This was already apparent in Kant’s schema, and most obviously in Hegel’s, where nonlinearity is a by-product of the particular way in which ‘set-backs’ are identified by an observer who privileges certain end points. In the case of Kant, progress may be “epistemically unwarranted”, as Møller confesses, but it is a “necessary presupposition” that should be assumed “for practical purposes” – namely, *for the purpose of* *achieving progress* (2021: 138-139). Kant’s nonlinear progress, it would therefore seem, is circular as well as subjective.

Can the same be said of complexity theory? In some respects yes. As we saw above, ‘circular causality’ and the celebrated ‘feedback loops’ of complexity theory are only circular loops at the level of appearance. It is obviously useful for humans to find patterns in nature and the social world, including what appear to us as ‘loops’, but a different being would extract different patterns. The patterns are *of* nature, they are *really* there, but it is us that places the pattern *on* nature, that *patternises*. When humans find images in the clouds, or look at the night sky and see the outline of a zodiac constellation, it is not as if this activity creates the clouds or the stars themselves, but the pattern identified nonetheless belongs to and comes from the subject projecting it. If three stars appear to align in a straight line to an observer then this is indeed a fact of reality, but it is a fact that belongs to the projecting subject. And when this subject stops projecting then the line will vanish, though the stars involved certainly won’t. Thus with each emerging pattern identified by the complexity scholar, the question must be posed: to whom is that a pattern, and whose to say there wasn’t a pattern there before, which you simply couldn’t see and mistook for chaos? As Bergson teaches us, “disorder is simply the order we are not looking for” (Bergson 2007: 80). So too with nonlinearity: who is to say it is nothing more than the linearity we weren’t expecting or are incapable of seeing? While this comment applies to nonlinearity in general, Gare points out that it is especially true of nonlinear dynamical systems, which “are capable of revealing the world to be unpredictable and capable of generating macroscopic patterns with their own dynamics; but this is at the level of appearance” (2000: 333). As he continues: “The underlying dynamics are deterministic and would appear to rule out anything but the appearance of emergence.” Because of this we should not get overly excited about the pretty patterns that appear in our computer models: “Since computers can simulate virtually anything, that a simulation appears life-like is of no great significance” (2000: 333).

There is a difference, however, between acknowledging the deterministic aspect of nonlinear dynamics and projecting idealised forms into the future. Bergson makes a similar point when critiquing the conventional understanding of ‘possibility’, in which future possibles are posed as ideal options ‘out there’, one of which is selected or ‘realised’. This way of thinking, whereby possibilities pre-exist “under the form of an idea” (Bergson 2007: 83) is based on the same reductive reasoning that guides ‘radical mechanism’ and ‘radical finalism’ – a reductionism that makes genuine emergence impossible: “This is why the idea of reading in a present state of the material universe the future of living forms, and of unfolding now their history yet to come, involves a veritable absurdity” (Bergson 1998: 341). If complexity theory is good at undermining presumptions of the classical model, it is because it avoids positing the inverse: the future is no longer closed, but neither is it radically open; ‘history matters’, but it is not a straightjacket; there is no progress as betterment, but time does ‘move on’, it advances and accumulates. And it is to be expected that complexity will have its own fair share of myths, metaphors and analogies – after all, it is a theory concocted by humans to try and *make sense* of reality. As Goodwin reminds us:

All theories have metaphorical dimensions which I regard as not only inevitable but also as extremely important. For it is these dimensions that give depth and meaning to scientific ideas, that add to their persuasiveness and colour the way we see reality. Science, after all, is not a culture-free activity. The point of recognizing this […] is simply to help us to stand back, to take stock, to contemplate alternative ways of describing biological reality. (Goodwin 1994: 32)

Complexity theory will never rid itself of this epistemological constraint, but this doesn’t mean it is marked for the scrap heap; it’s use is that it “tells a rather different story” (Goodwin 1994: 32). Goodwin is here referring to the story of life at the biological level, but it just may be that the story also helps us to reimagine progress and take us beyond its modern coordinates.

**Conclusion**

It is hardly novel to point out that progress has been one of the most ubiquitous and ethically suspect ideas from modernity to the present. Few are the ‘critically minded’ academics that would defend this idea, or at least the Eurocentric version complicit in colonialism and environmental destruction. This is because the intellectual critique of progress – from postcolonial scholars, existential philosophers and numerous other fields – has been convincingly and repeatedly made. And yet the conventional idea of progress depressingly remains as strong as ever. It is vital that the critique and deconstruction of progress goes on, even if the effects that we seek from it remain elusive, but perhaps what demands even more attention are *constructive* attempts to engender alternatives – by which I mean both *alternatives to* progress and alternative *notions of* progress. This paper has been preoccupied with the latter. All notions of progress are underpinned by a particular onto-epistemological theory of process and a cosmology of change, many of which draw from and/or connect to scientific frameworks. The task of this paper has been to explore how insights from complexity studies/theory might prompt us to *think and apply progress differently*. This has not been straightforward, for isolating exactly where and how complexity diverges from conventional accounts of change and progress is not as self-evident as some scholars suggest. Nonetheless, by articulating what is meant by complexity terms such as ‘nonlinearity’, ‘emergence’, ‘open’, ‘attractors’ and ‘path-dependence’ in contradistinction from the classical scientific framework that is coordinate with the modern idea of progress, this exercise has hopefully offered some leads on how we might move beyond the status quo of progress to a more complex understanding and experience of it.

\* \* \*

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1. For more on this see Burton et al 2019: 99-101. [↑](#footnote-ref-1)
2. Expanding on this point, some argue that the same input can lead to different outputs (Astill and Cairney 132; Smith and Jenks 2005: 155). [↑](#footnote-ref-2)
3. For a distinct but related critique of ‘homeostasis’ and ‘feedback’ in Weiner’s cybernetics see Bardin and Ferrari’s chapter in this collection. As they argue, Weiner uses these concepts in order to challenge static understandings of equilibrium and the ‘clockwork’ universe of modern science, but he ultimately replicates the same epistemological reductions, to the extent that “Weiner’s non-deterministic ontology was in fact mechanical determinism in disguise” (Bardin and Ferrari 2022: ADD PAGE NUMBER ONCE KNOWN). [↑](#footnote-ref-3)
4. In the first paragraph of their Preface to *Order out of Chaos* (2017: xxvii), Prigogine and Stengers offer two examples of phenomena that might ‘appear to us’ to be reversible, in the sense of a cycle/circuit or loop: the motion of a frictionless pendulum and the motion of the earth around the sun – but their point here is that this is merely an *appearance*, and more specifically an appearance *to us*. [↑](#footnote-ref-4)
5. For more on this see Lundy 2016. [↑](#footnote-ref-5)
6. Human goes on to equate this with “the old adage that the whole is more than the sum of its parts” (Human 2016:428), however according to others such as John Urry “It is not that the sum is greater than the size of its parts but that there are system effects that are different from its parts” (Urry 2006: 113). [↑](#footnote-ref-6)
7. For other examples in the social sciences see Durie and Wyatt 2007: 1936, and Van Uden et al 2001. [↑](#footnote-ref-7)
8. In commenting on the native inhabitants of Tierra del Fuego, Darwin says that “The perfect equality of all the inhabitants will for many years prevent their civilization. [Until this changes] there must be an end to all hopes of bettering their condition.” (see Goodwin 1994: 31). [↑](#footnote-ref-8)
9. “All the Mediterranean values, the triumph of the individual, of enlightenment and Beauty turn into pale, lifeless trinkets. All those discourses appear a jumble of dead words. Those values which seemed to ennoble the soul prove worthless because they have nothing in common with the real-life struggle in which the people are engaged.” (Fanon 2004: 11) [↑](#footnote-ref-9)