

A LONG AND COMPLEX REVOLUTION: THE THEO-ONTOLOGICAL EXPANSION OF SCIENCE

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The challenge that faces humanity is unique, for it has never occurred before. Clearly a new kind of creative surge is needed to meet it. This has to include not just a new way of doing science but a new approach to society, and even more, a new kind of consciousness. (David Bohm & F. David Peat)¹

The antithesis of nature to the mind, ‘as object to subject’, we now know to be false, yet so much of our thinking is based on it that to grasp the substantial unity, the sense of a whole process, is to begin a long and difficult revolution in the mind. (Raymond Williams)²

I HISTORY AND POSTMODERNITY

That a wide and far-reaching revolution is under way in science is not, yet, what we think historians will write about concerning our time. When future historians come to write the history of the late twentieth century, the obvious things they will notice are, certainly, the collapse of the Berlin Wall signifying the end of the USSR, and relatedly the apparent triumph of deregulated capital whose movements around the globe were facilitated by advances in computer power and use and the so-called ‘information super-highway’. The political responses to this in the 1990s have largely been some version of the ‘third way’ (which concedes that global capital in the form of multinational corporations and finance is, with deregulation and the world wide web, unstoppable - our old friend There Is No Alternative - but also includes the attempt, via global organisations facilitated by national governments, to incorporate multinationals into a more benevolent ‘world-view’). Various forms of increasingly unsuccessful mobilisation of Christian Democratic traditions have accompanied this. Similarly, future economic and cultural historians will doubtless note that such developments were aided by growing concerns over the commodification and vulgarisation of aesthetic activity as a source of pleasure and enlightenment; by increased anxiety about pollution, climate change, famines and droughts; by the manifest failure of market self-regulation exposed by the corporate scandals of the early twenty-first century; and, most strenuously, by the heightening polarisations between fundamentalist Islam and the West simmering dangerously in the Middle East during this period and especially evident after September 11 2001.

1. David Bohm and F. David Peat, *Science, Order and Creativity* [1987], London, Routledge, 2000, p207.

2. Raymond Williams, *The Long Revolution* [1961], London, Hogarth, 1992, p23.

3. Wendy Wheeler, *A New Modernity: Change in Science, Literature and Politics*, London, Lawrence & Wishart, 1999.

4. For an example of the meeting of these ideas, see the special issue 'Cognitive Models and Spiritual Maps', J. Andresen & R.K.C. Forman (eds), *Journal of Consciousness Studies*, 7, 11-12 (2000).

This mixture of aesthetic, ethical, political, scientific and religious - or more broadly 'spiritual' - concerns is often referred to by the term 'postmodern', of which groundlessness, fragmentation (especially of the self and its traditional anchors), vacuity, value relativism and loss of faith in the idea of progress, *plus* a concomitant yearning for meaning, groundedness and wholeness, seem to be some of the defining features. I have argued elsewhere,³ that postmodernism is better understood not as the 'end' of modernity but as a modernity-crisis, and that this is the necessary precondition of a very different 'new' modernity. But any such new modernity could never wholly depart from the scientific attitude that founded Western Enlightenment; a new *kind* of modernity could only come about if a new *kind* of science emerged. That is exactly what seems to be happening. Moreover, it is a change in scientific understanding in which all the features of the postmodern modernity-crisis can be found resonating and reorganising themselves across all the spheres which modern Enlightenment understanding tried to hold apart. This new science appears to refuse both Cartesian dualisms and the Kantian separation of spheres at the same time as it affirms the possibility of a properly scientific knowledge capable of containing multitudes - not only Kant's starry heavens above and the mystery of morality within, but also the practical and meditative insights of Eastern philosophical traditions.⁴ In the last two to three decades of the twentieth century, and hoving into wider view in the 1990s in particular, we can begin to see the shape of the ending of the remarkable period of Western Enlightenment modernity. With this we can say that the most striking features of the time we call modernity - a steady (but impoverished) secularisation accompanied by an increasing commitment to the uses of reason expunged as far as possible from affect, and the concomitant development of modern science and technology in which Western forms of development are deemed to be the only privileged forms of knowledge - draw to a close. The idea of progress, however, does not die with this; but it changes.

II COMPLEXITY

Many people will be familiar with the term chaos science; quite a few will also have heard of the term complexity science - of which chaos theory is a part. Possibly fewer, though, will be aware that this new science is providing one of the most significant theoretical bases for an equally new and exciting scientific development known as consciousness studies - also sometimes simply referred to as cognitive science. The breakthrough in cognitive science has come from two sources. The historically earliest in its effects on cognitive science was the development of cybernetics between 1943 and 1953. This made possible several new developments, including information theory (leading to the invention of information processing machines - digital computers - and the beginning of AI), systems theory (with wider applications in a number of sciences), and the first examples of self-organising systems

and emergence which would lead to the development of complexity science. The second was a return to phenomenology – especially the work of Maurice Merleau-Ponty and his insistence on the *embodied* nature of mind.⁵ Neuroscientists exploring the relation between reason and affect have in turn developed this ‘return’. Antonio Damasio’s research, for example, indicates that there is no such thing as a purely rational person; lesions in the brain which damage or destroy the capacity for neo-cortical processing of affective information from the amygdala (an evolutionarily early part of the brain) render such individuals incapable of normal functioning and ordinary living. Nobody just uses higher brain function reasoning when they think. We all, so to speak, use our gut responses also.⁶ Similarly, Gerald Edelman’s research uses complexity science to offer a powerful account of the organic production of mind as an emergent feature of mind-body-environment.⁷

Although current uses of complexity science go far wider - into, for example, the social sciences; management studies; physics; mathematics; meteorology; geography; economics; ecology; flow dynamics; cellular biology; and chemistry⁸ - it seems likely that it will be in the sphere of cognitive science that its hypotheses will initially be most far reaching in changing the ways in which we think about individuals and societies and culture and nature. Increasingly, mind is seen as an emergent feature of brain-body, and the latter as entirely culturally, socially and physically enworlded. A less obvious development, though, seems to be the ways in which understanding embodied selves-in-the-world as complex elements in co-dependent, evolving, complex, cultural, social and natural self-organising systems, seems to be turning so many materialist and scientific researchers and commentators not only to conclusions once the province of theology, but, even more strikingly, towards Eastern religious philosophies - especially Buddhism. This is a serious development arising out of science, and not to be lightly dismissed. The London School of Economics, for example, runs the Complexity Research Programme (CRP) within the Department of Information Systems. The CRP includes seminars, conferences, and major Engineering and Physical Science Research Council (EPSRC) and industry funded research projects. The Integration of Complex Social Systems (IcoSS) Project was awarded the largest grant from the EPSRC that the LSE has ever won.⁹ The Programme also has links to, for example: Cordis, the Future and Emerging Technologies unit in the European Commission, where the fostering and funding of complexity research is an important aim; the Local Government Management Board which includes a Learning Project for local authorities including a resource pack on learning from complexity; and VHA, a web-based complexity resource for healthcare managers, doctors and nurses. Several articles on complexity have also appeared in the *British Medical Journal*.¹⁰

It should not be thought that this kind of research council and industry funded research using complexity theory can be parcelled off from the rest

5. Francisco Varela, Evan Thompson and Eleanor Rosch, *The Embodied Mind: Cognitive Science and Human Experience* [1993], Cambridge, Mass., MIT Press, 2000.

6. Antonio Damasio, *Descartes' Error: Emotion, Reason and the Human Brain*, London, Picador, 1994.

7. Gerald Edelman, *Bright Air, Brilliant Fire: On the Matter of Mind*, Harmondsworth, Penguin, 1994.

8. One of the first books written on complexity theory was Ilya Prigogine and Isabelle Stengers, *Order Out of Chaos: Man's New Dialogue with Nature*, London, Heinemann, 1984.

9. For details, see <www.lse.ac.uk/lse/complex/>

10. P.E. Plsek & T. Greenhalgh, 'The challenge of complexity in health care'; T. Wilson & T. Holt, 'Complexity and clinical care'; P.E. Plsek & T. Wilson, 'Complexity, leadership, and management in healthcare organisations'; S.W. Fraser & T. Greenhalgh, 'Coping with complexity: educating for capability', all in *British Medical Journal*, 323, 6 (October 2001).

11. Roger Luckhurst, *The Invention of Telepathy*, Oxford, Oxford University Press, 2002, pp277-8.

of the science. The science and its theorisations are a holism. It emerges from the hard sciences, is used with particular attention to its emphasis on the importance of creativity in the human sciences, but its implications of an underlying and self-similar, self-generating (autopoietic) order to things, which leads to seemingly mystical or 'religious' points of view, are not simply disposable. In his study *The Invention of Telepathy*, Roger Luckhurst writes of the 'other history' to be written about the continual 'halo of occult phenomena that persists within the scientific disciplines', and provocatively suggests that the pursuit of elusive and improbable links might turn out to be one way in which 'constellated knowledges' can eventually be redrawn.¹¹ Complexity might be a version of this - and thus a continuation of the modern tango that science has danced with the strange since the nineteenth century - but its demonstrable explanatory power and scientific utility seem to raise the stakes in the matter of science and strangeness. This is, of course, a feature it shares with quantum mechanics where linear logic and Newtonian cause and effect appear to break down, giving way to the eerie behaviour of sub-atomic particles. Although no one has yet managed definitively to explain how this micro-world works, it *does* work, and much modern technology is based on it. On the other hand, the 'constellated knowledges' which complexity might redraw could just be those of the kind of science, which, up until now, has constituted *all* of modern mainstream science.

The purpose of this essay is twofold. It is to argue: first, that a realist (though non-positivistic) ontology is a prerequisite of any progressive criticism and practice; and second, that the scientific and cultural developments brought about by complexity tend to include considerations which reach much further into the nature of creativity, and art, philosophy and religion, *whilst at the same time maintaining absolutely realist commitments*, than has hitherto been the case in the sceptical scientific mainstream. To this end, my discussion will focus upon the work of philosopher of science Roy Bhaskar, and upon the work of physicists David Bohm and F. David Peat, and cognitive scientists Francisco Varela, Evan Thompson and Eleanor Rosch, as examples. Before I go on to offer a necessarily brief overview of some of these developments, however, this seems like a good point to give a sketch of what complexity science is.¹²

12. For interested readers, more detailed accounts can be found in a number of places. A good starting point would be Peter Coveney and Roger Highfield, *Frontiers of Complexity: The Search for Order in a Chaotic World*, London, Faber, 1995, and J. Briggs & F. David Peat, *Turbulent Mirror*, London, Harper and Row, 1989.

Unlike the laws of physics described by Newton, complex systems do not work on a linear cause and effect model. They are non-deterministic, and the effects they generate cannot be understood by a reduction to parts. The regular features of complex systems are: they are complex (not merely complicated) and evolving; they are non-linear and recursive (small causes can have huge effects - as mathematically described in non-linear equations); they are highly sensitive to initial conditions; they consist of an interaction of conservative and innovative forces; they are far from equilibrium (and can descend into chaos); they are self-organising (the political implications are probably anarchistic); they are open and dissipative (the self-organisation of renewed order out of chaos involves higher degrees of complexity and,

thus, energy). Complex systems exhibit a feature called ‘emergence’: the complex interactions of many parts produce features which are more than simply the sum of the parts and which cannot be reduced to the parts. They exhibit ‘self-similarity’, as demonstrated in Benoit Mandelbrot’s fractal geometry: it seems as though both natural and social complex systems have evolved via the evolution of a relatively few ‘solutions’ to problems. Self-similarity is evident, for example, in trees and their leaves, in the organisation of tree and root systems, in the organisations of nervous and circulatory systems, or in the pattern of river deltas. Such fractal geometry can be found in ‘coastlines, trees, mountains, galaxies, clouds, polymers, rivers, weather patterns, brains, lungs, and blood supplies ... This “noise” (or regular irregularity) is the bold signature of nature’s creative forces’.¹³ Ilya Prigogine and Isabelle Stengers, whose *Order Out of Chaos: Man’s New Dialogue with Nature*, was a fairly early book in the development of complexity, see ‘self-organising structures emerging everywhere: in biology, in vortices, in the growth of cities and political movements, in the evolution of the stars’.¹⁴ Classical physics encountered non-linear equations and systems, but sought to ignore them as ‘too disturbing’ - in Poincaré’s words at the end of the nineteenth century. In the early twentieth century, the problem of ‘noise’, or feedback, in systems was addressed by the development of probability. Physicists no longer looked for absolutely certain outcomes, which were deemed much too complicated, or chaotic, but for probabilistic ones. During the 1940s and 1950s, mathematicians and others developed the idea of systems theory and ‘noise’ further - most famously with Norbert Wiener’s coinage of the term ‘cybernetics’. The development of powerful computers in the 1970s allowed the mathematics of disturbance (or chaos) to be more effectively addressed. Now the growing understanding of complexity and non-linearity offers a quite radical change in our scientific, social-scientific and philosophical and creative understandings.

First, complexity theory and self-similarity across scales and phenomena affirms a holistic view of nature and culture that can be thought about in terms of nested systems within systems. For example: my brain is a complex system with the emergent feature of mind, but this mind arises as a result of my brain’s embeddedness in my body; my brain, and thus my mind, get to be organised the way they are because of my phenomenological experience as a body in the world. My mind/brain/body is an enworlded thing; and this enworlding is natural, cultural and social. Another way of putting this would be to say that I have a world offered to me by the creatureliness of my evolution in nature and culture. I am embedded in my life and in its social, cultural and biological history.

Second, complexity theory understands that reductionism is not applicable to - and can give no understanding of - living and open systems. Allied to this, such understanding also knows that changing a complex system is not to be achieved by issuing orders, pulling levers or any mechanical form or audit, since all of these attempts at control will have unpredictable

13. Briggs and Peat, *Turbulent Mirror*, op. cit., p91.

14. Prigogine and Stengers, *Order Out of Chaos*, op. cit., p138.

outcomes. Complex systems exist in a constant state of tension between order and chaos, conservation and innovation. Strikingly, the discovery of this creative tension is also found in the most recent genetic research. In *Century of the Gene*, Evelyn Fox Keller tells us that the idea that organisms themselves have evolved capacities for adaptation, should environmental stresses make such a thing desirable, considerably undermines the neo-Darwinian idea that organisms are the passive material on which external forces work. Fox Keller quotes James Shapiro as saying that ‘These molecular insights lead to new concepts of how genomes are organised and reorganised, opening a range of possibilities for thinking about evolution. Rather than being restricted to contemplating a slow process dependent on random (i.e., blind) genetic variation and gradual phenotypic change, we are now free to think in realistic molecular ways about rapid genome restructuring guided by biological feedback networks’.¹⁵ Or, as John Gerhart and Marc Kirschner put it in their 1997 book, *Cells, Embryos, and Evolution* cited by Fox Keller, ‘Throughout [the history of genetics], the organism remained a black box, translating random change in its genes into phenotypic variation to be acted on by selection. This black box is being quickly opened up by modern biology. In it we find that the connections between genotype and phenotype have been crafted by evolution to collaborate with evolution’.¹⁶ Fox Keller writes that ‘Our best yet theory of the origins of life is that it had not one origin but two, and lay in the symbiotic fusion of two separately evolved subsystems – one a rapidly changing set of self-reproducing but error-prone nucleic acid molecules and the other a more conservative autocatalytic metabolic system specialising in self-maintenance’.¹⁷ Politics, economics, social theory and management theory are now all being thought about in terms of this ‘creative tension’ between conservation and innovation also. Some people now think that art may be our creative way of imagining it through mimesis, or representation. Perhaps, as Alex Argyros suggests, art is our ‘best yet’ short cut through the ‘real time’ of non-linear equations.¹⁸

Third, complex systems have the feature of ‘emergence’ - that is a feature or element that results from the complex elements of the whole, and cannot be explained by reduction to parts. Complex systems are highly receptive to nuance, and are often best responded to in intuitive and creative ways (which takes us back to Damasio’s research on the importance of affect in normal human living). Complex systems are alive and creative. The aim of mastery and control - one the most troubling aspects of modern thinking - is literally deathly.

III PROGRESS AND MEANING IN HISTORY

Before going on to discuss further the work which I offer as scientific and philosophical examples of the trends I am discussing - now would, perhaps, be a good time to make my own position on these developments clear.

At the end of the story - although not the book - of Graham Swift’s 1983

15. Evelyn Fox Keller, *Century of the Gene*, Cambridge, Mass. Harvard University Press, 2000, p38.

16. *Ibid.*, p39.

17. *Ibid.*, p42.

18. Alex Argyros, *A Blessed Rage for Order*, Ann Arbor, University of Michigan Press, 1992.

novel *Waterland*, Swift's narrator, the history teacher Tom Crick, says: 'There's this thing called progress. But it doesn't progress. It doesn't go anywhere. Because as progress progresses the world can slip away. It's progress if you can stop the world slipping away'.¹⁹ For some time now there's been a fashionable idea that the world has already slipped away (or was never really there in the first place). This modern, or postmodern, idealism holds that discourse is all there is: no real world, no real bodies. This postmodern philosophical idealism, in which 'reality has slipped its anchor',²⁰ has often been thought of as progressive because of its general critique of Enlightenment - especially the latter's binaristic thinking and its confident assumption of Euro-centric ideas of progress. That Euro-centric ideas of progress have sometimes imposed a limited idea of universal values should not, however, be confused with the idea of progress as a general good. A universal claim to truth is not, in itself, a bad thing: if I claim that freedom is always better than slavery, equality before the law better than inequality, etc., I am making universal claims. Swift's narrator concludes his thoughts on the nature of progress by saying, 'My humble model for progress is the reclamation of land. Which is repeatedly, never-endingly retrieving what is lost. A dogged and vigilant business. A dull yet valuable business. A hard, inglorious business. But you shouldn't go mistaking the reclamation of land for the building of empires'.²¹ In other words, there is this thing called progress, but it's not what we once thought it was.

The intellectualist idealism of the postmodernist thinking referred to seems staggering. It has its roots, to be sure, in earlier religious idealisms, but it cloaks itself in a particularly contemporary self-righteousness - the mirror image of which is found amongst certain geneticists and neo-Darwinian evolutionary psychologists. Both 'positions' are equally reductive, the one on the side of language, the other on the side of that useful fiction The Gene. It is also, for example, this intellectualism that dogged AI research for years with its unrealistic model of the mind as a computer and the body as a machine. This thinking in AI persists, but the transitional ground is now being crossed via the development of research into cellular automata.²² Against this, the significance of embodiment, and a rejection of mind/body (and other) dualisms, is central to the new developments in complexity - especially in cognitive science where the development, also, of new scanning technology has contributed to important new insights into the relationship between body and mind (body/mind) and reason and affect.²³ With the growing ability to understand, and to calculate the laws of, non-linear recursive evolutionary systems, a way offers itself forward for the study of messy 'open' systems rather than simply the 'closed' system experiments upon which modern physical science has relied.²⁴

The inability to think about what might constitute progress is politically paralysing and socially (and emotionally and spiritually) disabling - as is a commitment-free value relativism. Language (or any semiology) is certainly important, but reality is *not simply* constructed in language. To believe it is

19. Graham Swift, *Waterland*, London, Picador, 1983, p291.

20. Julian Barnes offers a critique of the postmodern idea that representation replaces, or constructs, reality - rather than, as is more accurate, releasing it from positivistic assumptions, in Barnes, *A History of the World in 10½ Chapters*, London, Jonathan Cape, 1989.

21. Swift, *Waterland*, op. cit., p291.

22. See, for example, Steven Wolfram, *A New Kind of Science*, London, Wolfram Media, 2001.

23. See, for examples, again, Damasio, *Descartes' Error* and Edelman, *Bright Air, Brilliant Fire*.

24. For helpful discussions of this, see Andrew Collier, *Critical Realism: An Introduction to Roy Bhaskar's Philosophy*, London, Verso, 1994; see especially, chapter 4 'Stratification and Emergence'.

so is to commit the idealist epistemic fallacy that the world and its creatures did not exist prior to the existence of humans who could enunciate such existence.

IV COMPLEXITY AND PHILOSOPHY

The core of my argument here is that progress is real (although, of course, historically, geographically, temporally, politically, socially etc. uneven) and dialectical through and through. The only way of grasping and making sense of this is by understanding that the arrow of time is not (as classical physics thought) reversible; it goes one way only, and in human consciousness and experience it is expressed dialectically. The person who has made this argument most thoroughly, and in so doing brought our understanding of dialectic development up to date, is the philosopher of science Roy Bhaskar, whose critical realism provides the philosophical ontology to chaos/complexity's scientific ontology. I will discuss Bhaskar's philosophical contribution in the section that follows. Here I want to make a few comments on the return to the philosophy of phenomenology that accompanies the scientific recognition of the importance of embodiment. Although this is a *materialist* move (as opposed to Hegel's phenomenology of *spirit*), it develops towards a dialectical sublation of even that opposition. This is true both for science and for philosophy.

Relatively recent shifts in scientific explanation should be expected to mirror developments in socio-political developments and concerns. More importantly, these scientific shifts encounter and sublimate more or less *all* the historically necessary oppositions (between mind and body; science and art, reason and affect, for example) that characterised the first scientific modernity. But perhaps most important of all (and possibly hardest to grasp because it is in the nature of the bourgeois ideology of Western Enlightenment, in which we all swim, to be scandalised by the dialectic, and to prefer radicalisms which, however seemingly revolutionary, continue to support the idea that Western modernity ushers in the preconditions of the end of history, and that things will now always remain essentially the same in regard to knowledge and society) the very notion of reason itself begins to change. Against the formerly prevailing Cartesian dualism, reason now comes to be understood as affective, embodied and enworlded.

Since the dialectic, as we know, proceeds by indirection, we can certainly see prefigurations of this moment in earlier ones. Benjamin's notion of the appearance of messianic time in historical time is one, for instance;²⁵ perhaps more powerful is Kristeva's argument in the 1979 essay 'Women's Time' in which she argues that women, in their experience of maternity, experience themselves both in linear time and in 'monumental' time, and that, for the generation of women that come after the first wave of egalitarian feminists, it must become possible to reconcile both.²⁶ There, Kristeva refers to psychoanalysis in order to recognise the historic nature of the need to think

25. Walter Benjamin, 'Theses on the Philosophy of History', *Illuminations*, Harry Zohn (trans), New York, Schocken Books, 1968.

26. Julia Kristeva, 'Women's Time', Toril Moi, (ed), *The Kristeva Reader*, Oxford, Blackwell, 1986.

and practice the coming together of linear time with cyclical and monumental time as an effect of women's emancipation.

Yet where Kristeva sees the failure to address this as leading to religion and mysticism (a traditional resort in the face of an empty historicism coupled with a hermeneutically impoverished utilitarianism), Varela, Thompson and Rosch counter analytic philosophy's (and first modernity science's) refusal to admit the embodied nature of experience and consciousness by recourse to the ancient intelligences of Eastern meditative philosophies which provide a language for the nature of the experience of selfhood. With this, we can see the dialectical movement at work in a number of ways. The growing insistence on the importance of phenomenological embodiment from within cognitive science begins a powerful binding up of the opposition between object and subject that pits scientific truth against subjective experience. The growth of the connectivist cognitive idea of knowledge and self-organisation as an emergent feature of networks (from cellular biology and genetics through to minds and societies - nicely caught in Marvin Minsky's coinage 'the society of mind') binds up the modern opposition between the individual and society. The scientific use of spiritual insights from Eastern philosophy to discover a language capable of describing the experience of self-consciousness begins to bind up the first modernity's 'science versus religion and poetry' opposition. And lastly, the combination of a phenomenological understanding of embodiment and the Buddhist understanding of the illusion of a transcendent Self bind together the philosophical thought of Heidegger and Merleau-Ponty with the critique of essentialism produced by post-structuralist theories of the evanescence of the self. But importantly they do so by allowing a scientific and *biologically based* version of constructivism that resists the idealism and value relativism of the wilder claims of socio-linguistic constructivism. In other words, with the body in mind, we are certainly anchored in the reality of body and world as the grounds upon which biological and social evolution take place - and, therefore, we *can* assert the superiority of certain values and experiences over others - but we are not obliged to adopt a positivistic point of view. We can acknowledge that the world which offers itself to us is *for* us, and for nature, inasmuch as the life we see and know about, and the physical laws we manipulate, have successfully evolved and *work*, but that is not necessarily the whole story. Different species, for example, almost certainly find different 'worlds' offered for them.

With this, and via cognitive scientific understandings of the features of complex systems such as networks and emergence, a new scientific understanding of the relationship between biology, history (including evolutionary history), culture and society becomes possible. In order to give an example of these anti-positivistic developments (non-positivism is also at the heart of Bhaskar's philosophy), it's worth quoting Varela et al on the current state of play between 'old' and 'new' views in science and philosophy. Noting Anglo-American philosophy's attachment to positivist theories of

27. Mark Johnson, *The Body in Mind: The Bodily Basis of Imagination, Reason and Meaning*, Chicago, University of Chicago Press, 1987, p175.

28. R.J. Gregory & J.G. Wallace, 'Recovery from Early Blindness – A Case Study', *Experimental Psychology Society Monograph Number 2*, London, 1963.

29. Varela et al *The Embodied Mind*, op. cit., p150.

30. Roy Bhaskar, *Dialectic: The Pulse of Freedom*, London, Verso, 1994.

31. Wendy Wheeler, 'Stars and Moons: Desire and the Limits of Marketisation', in Geoff Andrews, Richard Cockett, Alan Hooper, Michael Williams (eds), *New Left, New Right and Beyond: Taking the Sixties Seriously*, Basingstoke, Macmillan, 1999.

language as against Continental phenomenological traditions which recognise, in Mark Johnson's words 'that understanding is an event in which one has a world, or, more properly, a series of ongoing related meaning events in which one's world stands forth',²⁷ Varela et al observe that philosophical interest in embodiment of the sort necessary to thinking with complexity science requires the strengths of a phenomenological approach of the kind associated with the work of Merleau-Ponty.

Here, the fact of embodiment, and of understanding that a mind grows from embodied being, does not entail positivist commitments. Work on perception in neuropsychology has demonstrated for some time that perception is learned, not given, and our apprehension of the world is made in our senses. Richard Gregory's study of recovery from early blindness, for instance, shows that the world of the newly sighted remains dominated by the world as learned by the senses from infancy on. The subject of his 1958-9 study was, for example, once his sight was restored, still never able properly to 'know' an object without the use of his hands to explore things. This was the blind world that was 'offered' for him for the first fifty years of his life, and it was only in this world that he could fully know objects.²⁸ Our worlds, the worlds that are 'offered' for us, are made in our bodies, our families, our communities and our cultures. The world is real, but it isn't 'independent of the knower': 'If we are forced to admit that cognition cannot be properly understood without common sense, and that common sense is none other than our bodily and social history, then the inevitable conclusion is that knower and known, mind and world, stand in relation to each other through mutual specification or dependent coorigination'.²⁹

V COMPLEXITY AND ROY BHASKAR

In 1994, Roy Bhaskar published *Dialectic: The Pulse of Freedom*.³⁰ This book marked the culmination of his development of critical realism over the previous nearly quarter of a century, and initiated the next development to be found in *From East to West* published in 2000. The turn from West to East was mirrored during the 1990s by a wider cultural return to the emblems of 1960s new-ageism.³¹ In the 1990s, these sixties emblems reappeared in the High Streets as fashion garments and lifestyle accessories, but clearly, what they signified for the earlier counter-culture had not gone away. The developments within critical realism from the 1970s to the 1990s - of a realist ontology of 'open' systems - had realised, *as philosophy*, something of the buried spirit, which eventually reappeared as mainstream merchandise from around 1993 onwards.

Unlike contemporary scientific *suspicionistas*, Roy Bhaskar wants to be able to give an account of science as a project for truth - with truth in mind. Equally, Bhaskar wishes to expose the limitations of empiricism and positivism (basically the failure to attend to the ways in which our cognitive organisation plays a part in making our world). For Bhaskar, science consists

of transitive knowledge, but always has an intransitive aim - i.e. to probe more deeply into the 'transcendental question': 'and what must be true for this to be the case?' The scientific question is transcendent because it is always and everywhere the condition of science, even though the continued asking of that question may lead us eventually to change our notion of what science *is*. In other words, scientific knowledge consists of a deepening of our knowledge of the structures which are the source, realised or unrealised, of this or that effect. Natural science, Bhaskar thinks, must, though, be 'rescued from its positivist straight-jacket'.³² This latter was originally perceived as a progressive stance, but, under advanced capitalism, it is now used simply to do away with any subtlety of thought which might challenge the simple and self-interested quasi 'scientific' worldview of instrumental reasoning. For Bhaskar, the usual forms of anti-positivism in capitalist societies 'from the romantics through neo- Kantians to Rorty' are generally ineffective because they fail to challenge the dominant scientific positivism of bourgeois societies - seeing science either 'as an enemy or as "alright in its place" but irrelevant to the things that matter'.³³ Clearly then, Bhaskar's critical realist project is to affirm science as a source of real material truth and human emancipation whilst arguing that its epistemology is profoundly limited when reduced to empiricist and positivist accounts. Equally, and for obvious reasons, he is keen to refute the politically dangerous idealism of the playful socio-linguistic constructivists and so-called postmodernists for whom science is a set of discourses rather than a potential source of truth. (I say 'so-called' because my own view of postmodernity is that it is not some kind of final revealed truth of the relativism of all values, but a stage of exhaustion, or perhaps more accurately of dialectical contradiction, in the tradition of one dominant world-view - that of the first science and the first modernity.) In his refutation of both idealism and empiricism, Bhaskar is keen to offer an account of scientific knowledge that is not the ideologically befuddled version that is the common sense of bourgeois capitalist societies. As Andrew Collier puts it:

Reality is de-realized by a radical form of the epistemic fallacy, phenomenalism, for which we know only our sense impressions, which constitute 'the empirical world'. Science is de-socialised by the reification of facts, according to which nature, so to speak, presents itself to science on a plate, ready cooked and sliced into 'facts'. Thus the epistemic fallacy is complemented by an 'ontic fallacy', reducing knowledge to its object, effacing its process of production. This role reversal between science and nature is the central feature of P as described by Bhaskar.³⁴

Bhaskar, himself, notes that this ideologically freighted positivism ('P') 'can generate an ideology of technocratic expertise and managerial authority as well as, and perhaps to go with, its quasi-egalitarian mystique of commonsense and everyman'.³⁵ This is the version of 'scientifically endorsed'

32. Collier, *Critical Realism*, op. cit., p102.

33. *Ibid.*, p102.

34. *Ibid.*, p104. 'P' is the notation Bhaskar uses to designate positivism as a real, actually useful in the real world, cognitive structure or mechanism. In other words, we need a positivist apprehension to get about in the world, but this leads us to the mistaken view that what we sense is simply all there is. 'P' is a necessary development in science, but it has now outlived its usefulness.

35. Bhaskar, *Scientific Realism and Human Emancipation*, noted by Collier, op. cit., p272.

politics and political economy with which we are all so familiar.

Bhaskar's attempt to offer a philosophy of science capable of accounting for scientific knowledge in closed (laboratory) and open (real world as life-world) systems, whilst refusing positivistic forms of empiricism, puts his work firmly in the complexity theory field – as is evidenced by his development of the terms stratification and emergence to describe a science of open systems. In place of stratification, David Byrne uses the rather friendlier term 'nested systems', and, in *Complexity Theory and the Social Sciences*, he makes explicit both his concern over 'what has gone wrong with sociological theory' as part of the emancipatory project supported by modern science, and also affirms the 'linking of critical realism as a philosophical ontology with chaos/complexity as a scientific ontology'. This combination, he continues, 'should be fatal for postmodernism as an intellectual project'.³⁶

36. David. Byrne, *Complexity Theory and the Social Sciences*, London, Routledge, 1998, p8.

Taking up the challenge of Heideggerian phenomenology in his 1994 book *Dialectic: The Pulse of Freedom*, Bhaskar argues that science is precisely 'engaged concerned human activity with *Dasein* exploring its *Umwelt* with its equipment (language, pre-existing, yet not necessarily articulated, knowledge and tools) constituting a "referential totality" ready-to-hand'.³⁷ Noting that the dialectic is often thought about in the classical triadic-structure, linear, way, Bhaskar points out that dialectics is not *really* like this (in the real world one might say). What is actually going on is better described as dialectics in the plural: '*ontological dialectics; epistemological dialectics; relational dialectics; practical dialectics*' and so on. Clearly, to *be* is to be in the dialect of being: meeting the object world and the life-world, and being in struggle and negotiation with these objects, forces, people, events, as for every other. Clearly, too, this means movement, learning and deepening, within a history and culture which will impose its own limits upon development, but which is also itself dialectical. But neither, Bhaskar points out, is this movement of development always characterised by obvious struggle rather than, say, by 'connection, separation or juxtaposition', and neither is there always sublation. One thinks here, for example, of the obvious truth of Mircea Eliade's arguments.³⁸ Religion and superstition do *not* go away. These things have *not* been fully sublated. Some people are committed to a certain kind of rational humanism, for instance, *in exactly the same manner* that others are committed to religious beliefs.

37. Roy Bhaskar, *Dialectic: The Pulse of Freedom*, op. cit., p14.

38. M. Eliade, *The Sacred and the Profane*, W.R. Trask (trans), London, Harcourt, 1959.

But at this point we might ask: why use the idea of dialecticism? Why not take the post-modernist line and say that things just change, but that we can't talk about progress or development? First, it seems simply wrong to say that we can't talk about progress; just because the latter is uneven is no argument against its taking place. Its unevenness is surely an argument for a better share of progress all round. The post-modern argument that the idea of progress is a teleological delusion not only conflates two separate ideas (the idea of progress does not necessarily entail any *telos*) but also only ever seems to be made by those reaping the benefits of scientific, technological, material progress.³⁹

39. In this regard, see Kate Soper's arguments in 'Postmodernism, Subjectivity and the Question of Value', Judith Squires (ed) *Principled Positions: Postmodernism and the Rediscovery of Value*, London, Lawrence & Wishart, 1993.

In the opening pages of *Pulse*, Bhaskar states his aim as follows: 'In this study I aim to revindicate negativity. Indeed, by the time we are through, I would like the reader to see the positive as a tiny ripple on the surface of a sea of negativity'.⁴⁰ The difference that he introduces into the Hegelian dialectic is that he widens types of negation. What Hegel means by negation is what Bhaskar terms 'real negation' which connotes, among other things, the hidden, the empty, the outside, or desire, lack and need. It is this which 'drives the Hegelian dialectic on and it is our *omissive critique* of Hegel – his failure to sustain certain crucial distinctions and categories (including in the end that of absence itself) – that must drive the dialectic past and beyond him.' To 'real' negation Bhaskar adds 'transformative negation' and 'radical negation'.⁴¹ He needs these different kinds of negation because in the real world of 'open' systems, not every logical or experiential contradiction involves the same kind of negation: some can continue for considerable periods of time having only local effects whilst others are more globalised; some kinds of contradiction do not involve sublation – or at least not until a sufficient weight has built up, and that could be a very long time or never (in *this* world).

40. Bhaskar, *Pulse*, op. cit., p5.

41. Ibid., p5.

Essentially, the attempt to give a rigorous ontology based upon, and moving beyond, the linearity of Hegelian and Marxian dialectics represents the attempt to provide a philosophical basis for complexity. The insistence on different kinds of negation arises from Bhaskar's attempt to describe dialectical change as it must be in the real world. One might say that moving a description of the dialectic 'beyond' Hegel is something akin to moving a description of causality beyond Newtonian physics whilst remaining in the familiar macro (rather than the strange quantum micro) world. This, of course, is a description of the science of complexity: Bhaskar's word for 'complexity' is 'dialectic'. Quite evidently, then, he wishes to retain the word precisely because he sees his own work as absolutely in and of the dialectic as described by Hegel and as materialised in Marx. He wants a philosophical grounding of it – a philosophy of the real world that is an open, or complex, system, but not one that is idealist. Like Marx, Bhaskar wants a materialist dialectic, but one of open non-linear systems in place of Marxian linear dialectics with their (relatively speaking!) simple forces, negations and determinations. It should be emphasised however, that this materialism is not limited by science; the latter is simply seen as a method of great 'explanatory scope and power'. Science is not seen here 'as a supreme or overriding value, but only as one among others to be balanced (in a balance that cannot be wholly judged by science) in ergonic, emancipatory and eudaimonistic activity ... Reality is a potentially infinite totality, of which we know something but not how much'.⁴²

42. Ibid., p15.

Once it has been grasped that Bhaskar is trying to give – especially in *Dialectic: The Pulse of Freedom*, and *From East to West* – a philosophically rigorous account of complex systems, some of the considerable difficulties of his dense texts are reduced. The central importance of negation

(negativity, absences, gaps, silences and so on) in Bhaskar's work is that it is, in all its manifold ways, absolutely what makes freedom possible. One can think of 'negativity' or 'absence' in the critical realist dialectic via the idea of 'the space to move', or the absolute *necessity* of nothing/lack in generating possibility. The idea of negativity is central for Bhaskar because 'the space to move' also presupposes human agency as the included contradiction in the dialectic of being - understood as '*Dasein* in its *Umwelt*'. Again, absence/receptivity is dialectically one with the agency/presence of properly responsive willing.⁴³

43. But it is precisely one of the features of modernity that much of the life-world is experienced as an assault: one cannot be open to it – or at least not without the general development of a much greater and wider environmental and aesthetic sensibility.

44. Adam Phillips, 'A Stab at Hinting', *The Beast in the Nursery*, London, Faber, 1998.

45. Bhaskar, *Pulse*, op. cit., p43.

46. Bhaskar, *From East to West: Odyssey of a Soul*, London, Routledge, 2000.

47. I am thinking here of the work of South African writer Olive Schreiner as described by Carolyn Burdett in *Olive Schreiner and the Progress of Feminism: Evolution, Gender, Empire*, Basingstoke, Palgrave, 2001.

VI CREATIVITY

Another way of talking about the capacity for creative negativity or receptive being and responsive willing in the world (Keats's 'negative capability' and what Hegel called 'tarrying with the negative'), is to consider the state of mind it describes. This is what Keats referred to, in a letter to his friend Reynolds, as a state of 'diligent indolence' into which space the creative idea emerges.⁴⁴ Creativity, in other words depends on the 'negativity' of receptivity - a kind of 'making space for'. This is processual experience, and as Bhaskar says, 'Dialectic is at the heart of every learning process'.⁴⁵ In other words, the absencing of self in one's being in the world is the phenomenology neither of spirit alone nor of body alone; it is the phenomenology of the whole creature.

In his most recent book *From East to West: Odyssey of a Soul*, Bhaskar describes the dialectical movement in his own work - each stage more or less represented by a Bhaskar book.⁴⁶ As with Varela, Peat and Bohm, Bhaskar finds that, for the concepts he wishes to express in *From East to West*, it is necessary to draw upon the vocabulary of Eastern philosophical traditions and, as many others frustrated by the semantic and linguistico-cultural limitations of Western modernity have done before him, upon allegory.⁴⁷ As well as considering that the Eastern philosophical tradition really does contain insights missed or occluded in Western modernity, this turn might also be thought of as a strategy similar to Derrida's practice of putting words 'under erasure' - in this case because the Western vocabulary simply can't do justice to a thinking that needs to exceed it. For Bhaskar, reality is best described not by the usual, two-tier (grounding, manifestation) analysis of dispositions, but by a three-tier organisation of dispositional realism: power (or possibility), exercise and actualisation. Put briefly, this means that whilst, in experimental laboratory conditions, cause and effect can (hopefully) be demonstrated, in complex systems matters cannot be the same. In such systems, a constant conjunction of events is neither sufficient nor necessary in terms of explanation because powers, dispositions, etc. are far too various, admixed and so on (complex in other words) for us to make any certain judgements of cause and effect at all. According to Bhaskar, the failure to see that this is the case is best designated by the term *maya*, or the

veil of illusion. Simply put, the best concept for describing the nature and extent of what we know – as opposed to what *could eventually* be known (*really*, and thus *scientifically*) – is *maya*. And this is so because Bhaskar wishes to use the Eastern tradition further to explore the state of mind in which it is possible to live and to act (socially, politically and so on) with this properly in mind. The painstaking details of Bhaskar’s ontological arguments are clearly intended to make impossible any separation of religious/poetical thought from scientific thought. That this should be achieved through a rigorously scientifically based ontology - rather than through a philosophy that is, at heart, anti-science and anti-technology (such as Heidegger’s phenomenology) is a major step forward in the thinking that Enlightenment inaugurated.

For Bhaskar, there seems to be no reason why something as obviously real as the change and growth of the self over time (although not always necessarily fully actualised in any particular case) should be accounted as non-material. Indeed, for Bhaskar, everything is real - even *maya*. The dialectic is the *real* process by which *maya* comes to be seen as such - a necessary and real, but sublatale, stage in our account of reality. The Marxist concept of alienation thus has two aspects in Bhaskar’s thought: *real alienation* and *self-alienation*. Together, these account for all the conceptual alienations that Bhaskar describes as the alienations and malaises in contemporary thought. He writes: “Transcendental realism, especially as developed in dialectical critical realism, insists that everything, including logical contradictions, category mistakes and concepts generally (not to mention human actions), is part of being. To exclude *anything* is to alienate it, dualistically split being and so initiate a chain of avidya-tina formation’.⁴⁸ Avidya [ignorance, the veil of *maya*]-tina [there is no alternative] formations can be understood as the condition of the dialectic when it is immersed in a real contradiction (or series of related contradictions) in which sublation is blocked. In its place, a ‘tina compromise formation’ is articulated. Take, for example, the very widespread sense of alienation that the processes and practices of modernity have produced. Science, technology and societal rationalisation all have obvious benefits, but they are also unable to offer an effective response to the spiritually affective desert that they tend to bring about. Modern societies affirm this moral or spiritual need, but there is no strong will, amongst Western governments and other institutions, to oppose this modern reasoning. Among Islamic theocracies fundamentalism and ignorance sit alongside scientific development in a similarly unresolved manner. ‘There Is No Alternative’ we are told, and thus the tina compromise formation results in a theory/practice inconsistency.⁴⁹ Why *avidya-maya*? Why not just ideology? As with ‘P’ for ideologically freighted positivism (rather than positivism simplex), for Bhaskar, the word ideology evidently doesn’t do enough work now. What *maya*, the veil of ignorance in Buddhist philosophy, describes is not simply an illusion that could be wiped away with words, or more intellectual knowledge. To be without such illusion in

48. Bhaskar, *From East to West*, op. cit., p34.

49. *Ibid.*, pp5-6.

the sense that the Eastern philosophy brings in would be to be more attentive to one's embodied being in the world in order to understand, fully and from the inside as it were, the various violences of the Western capitalist domination of economic, labour and social relations, to which we are told There is No Alternative. To move beyond these types of illusion would be to deepen experience so as to feel self and other alienation *in the gut*. It would also be to strive, as many certainly have done, to give this adequate expression, first as a philosophy and then as a language, a practice and a politics. All this is to pose again the question 'What is Enlightenment?' and to answer that, yes, it is philosophy, it is science, it is progress – but differently conceived as phenomenological ontology, complexity and emancipation holistically realised.

Clearly, then, only the emergence of a *new* kind of science that challenges positivism (or 'P') can break the hapless rigidity so that dialectical movement can continue. This is precisely the change in science itself that this essay is attempting to outline. For Bhaskar, what this radical shift inaugurates is, amongst other changes in ontological understanding, a *new* understanding of the importance of creativity. This was, of course, prefigured in Romanticism, but now it is no longer in opposition to properly scientific understanding.

For the Romantics, 'creativity' named the soul's freedom in an increasingly mechanistic and 'disciplined' world. Being creative is increasingly difficult in a world more and more dominated by ideas of 'correct' behaviour (or behaviour standing in need of correction in one form or another - political, psychiatric, etc.). Being creatively receptive is also very difficult in the modern world in which so much is sensually and intellectually perceived as an assault (too much 'noise'). The contribution of complexity theory, here, is significant. Where scientific thinking once assumed that order was the ideal condition,⁵⁰ it is now recognised that complex, evolving and open systems must always exist at the edge of chaos. Spontaneous creativity is the marker of complex systems and ensures their survival. As noted above, creativity, and the possibility of creative adaptations, seems to be built into the life of the genome itself. The issue is how to be creatively receptive now. Bhaskar's answer is that self-alienation and societal alienation must be addressed. The former is to be addressed by the exploration of Buddhist meditative practices and wisdom (the argument, also, of *The Embodied Mind*), and the latter by complexity (in *The Embodied Mind* particularly complexity applied to cognitive science).

The general thrust of *From East to West* is remarkably similar to a number of recent complexity science books written by scientists. Centrally, these arguments affirm holism, creativity and, strangest of all to the mind reared in the tradition of Western Enlightenment, a dimension that can only be described as a return to the sacred. It is this holistic, self-enfolding, recursive, self-organising, evolving, fractal totality - that, within our own range, we can experience *within* via creative or meditative practice, and *without* via

50. Herbert Spencer was deeply shocked by the realisation that order equals death. See Burdett, op. cit., pp42-4. See also my contention that Freud, in *Civilisation and Its Discontents*, implicitly equates order with the death drive, in *A New Modernity?* op., cit., p21. All living systems exist far from equilibrium - at the edge of chaos.

complexity science - that Bhaskar, embarrassingly to some, calls 'totality' or 'God'. Just as each stage of our evolutionary development is enfolded within our ontological development (ontogeny recapitulates phylogeny), so humans and human self-consciousness are enfolded within the ontological 'totality'. And, on the basis of self-similarity, if *we* are self-conscious, then so is the totality: God. Equally, as ontogeny recapitulates phylogeny, all life is a part of the totality and, the totality being what it is, 'truly universal enlightenment and flourishing' for 'all souls and all species' is an eventual (although not necessarily on this planet) certainty - sometime somewhere.⁵¹

Although Bhaskar draws out the full implications of complexity science, it is worth comparing what he claims with scientific writers such as Briggs, Peat, Bohm and others - who certainly suggest that Eastern philosophies got there first, but who are not quite so bold as Bhaskar. For these other writers also, complexity presents a radical challenge to the science developed in the Western tradition.

In *Science, Order and Creativity*, physicists Bohm and Peat argue that the order of complex systems is both generative and implicate. Generative order is creativity (and can be seen in works of art: their argument deduces that 'the generation and evolution of life are thought of as more like a work of an artist than of an engineer'),⁵² and implicate order is a special case of generative order. The nub of the argument (Bohm and Peat offer practical experiments as examples) is that what appears as randomness is not necessarily so: a deep, or implicate, order can be discovered within seeming chaos. Self-organisation can be understood as a manifestation of the implicate order. This is, incidentally, the basis of Bohm's alternative theory (alternative to the dominant Copenhagen School account, that is) of 'the basic quantum properties of particles such as electrons'.⁵³

Bohm's implicate order of enfoldment is what Bhaskar describes as the unfolding of the dialectic. Although the two terms sound like opposites, they are actually describing the same process. Negation in Bhaskar is freedom, creativity and the room to move (to make changes). In Bohm and Peat the free action of the implicate order of open systems (life) depends on freedom and creativity. Like Bhaskar, they argue from scientific premises that life is not fortuitous but 'enfolded universally, deep within the generative order'.⁵⁴ The enemy here is rigidity - especially institutional. Bhaskar's term for this is 'bourgeois ideology'. Bohm and Peat also stress the need for what Bhaskar describes as negation, absence, openness or receptivity: 'For creativity to flower there must be an easy mobility of sensitive awareness so that attention can move freely and in any order that may be relevant at the moment in question'.⁵⁵ As is also the case with Bhaskar, this leads Bohm and Peat into a consideration of the sacred point of view. Being attentive to the world, being *receptive* to the world as a totality most easily experienced in the sensual and aesthetic pleasures of natural things, was replaced, they suggest, at first by religion (which held the dimension of the mysterious pleasure open - even as it succumbed to institutionalisation), and then by

51. Bhaskar, *From East to West*, op. cit., p45.

52. See Bohm and Peat, op. cit., Chapter 4: 'The Generative Order and the Implicate Order'. Citation from p163.

53. Ibid., p174. See also, David Bohm, *Wholeness and the Implicate Order*, London, Routledge & Kegan Paul, 1980.

54. Bohm, *Wholeness and the Implicate Order*, op. cit., p201.

55. Ibid., p216.

56. For an account of how this sensitivity to the natural world can restore a cosmic sensuality, see David Abrams, *The Spell of the Sensuous*, New York, Vintage, 1996.

57. Bohm & Peat, *Science, Order and Creativity*, op. cit., p268.

58. See Argyros, *A Blessed Rage for Order*, op. cit.

science - which, in its beginnings, also promised an account of totality.⁵⁶ Here again, the Western sensibility and its blockages finds itself relieved by a turn to the East, even whilst recognising that the westernisation of Eastern cultures has brought both to something of an impasse. What Bohm and Peat call for is a new creative order in which, in effect, dialectical movement (they call it 'free play in *communication*') is possible.⁵⁷

VII A LONG REVOLUTION

In setting out these arguments and examples, I have sought to show that significant movements are afoot. The writers discussed here are all, in their own ways and languages, aware of both the *fact* of change (instantiated mainly here in science) and also of their own non-positivistic contributions to a change that is of a different quality to earlier - pre-complexity - versions in and of the received orders of modern knowledge. These people - as scientists and philosophers of science - find themselves needing to deploy languages (psychoanalysis from the West; philosophy from the East) that, at their best, throw down a substantial challenge to the order and understandings of Western scientific modernity. They, themselves, talk of paradigm shifts in how we think about what counts as knowledge (science), and try (often through recourse to Eastern philosophical traditions) to find a way of talking about real life (the life-world or *Umwelt*) in ways that do justice to our experience of it, rather than abstracting it via laboratory conditions which bracket out the openness of the real world.

Complexity science seems to me to be a major advancement in our scientific ability to talk about the real human (and non-human) world. That it seems to require discussions of mystery - thus rejoining art, science and religion (or, for the Kantian minded, aesthetic judgement, pure logical reason and practical moral reason) - seem interesting, humane and timely. Art, for example, regains its place as a significant human activity. Mimesis seems to be a real and important feature of communication in human complex systems; it's the way, as Alex Argyros suggests, in which human intelligence creatively and imaginatively short cuts the 'live through' requirements of complex systems.⁵⁸

In the 1990s, and with the arrival of complexity science on a wider public stage, taking science seriously became easier for those of us standing in that long line of aesthetic objectors to the limitations of modernity that Raymond Williams named in *Culture and Society*. A few years later, in *The Long Revolution*, he wrote:

At one level we can oppose art to science, or emotion to reason, yet the activities described by these names are in fact deeply related parts of the whole human process. We cannot refer science to the object, and art to the subject, for the view of human activity we are seeking to grasp rejects this duality of subject and object: the consciousness is part of the reality,

and the reality is part of the consciousness, in the whole process of our living organisation. Coleridge spoke of 'substantial knowledge' as that intuition of things which arises when we possess ourselves as one with the whole.

This realisation, the capacity for 'substantial knowledge', is the highest form of human organisation, though the process it succeeds in grasping is the common form of our ordinary living. At a less organised level, we fall back on what Coleridge called 'abstract knowledge', when we think of ourselves as separated beings, and place nature in antithesis to the mind, as object to subject, thing to thought, death to life. The antithesis of nature to the mind, 'as object to subject', we now know to be false, yet so much of our thinking is based on it that to grasp the substantial unity, the sense of a whole process, is to begin a long and difficult revolution in the mind.⁵⁹

59. Williams, *op. cit.*,
p23.

Is complexity, perhaps, the science of the long revolution?