

Autopoiesis and the Complexity of Life – Bob Clarke

1. Introduction

The term '**Autopoiesis**' was derived from ancient Greek: αὐτο- ('auto-') meaning 'self', and ποίησις ('poiesis') meaning 'creation' or 'production'. It was coined in 1972 by two Chilean biologists, **Humberto Maturana** (b. 1928) and **Francisco Varela** (1946-2001) to recognize the fact that the main activity of all lifeforms known to science, from single cells upwards, is *self-production* and *self-preservation*. Our bodies are beaver away *all of the time* to keep us alive, and, measured in terms of energy expended, our own self-production and protection are by far the main activities of our bodies, though we are not generally conscious of this continuing effort. For *Autopoiesis* this basic fact is a major prerequisite for any adequate understanding of what Life is, it is the major factor influencing the cognition and behaviour of all lifeforms.

Maturana & Varela's first very formal publications on *Autopoiesis*, e.g. '*Autopoiesis and Cognition*', appeared from 1972 to 1980.¹ The concept has evolved significantly since that time. Originally applied to single cells, it has since been applied to Life as a whole. Whilst never 'mainstream', it has engendered important scientific and philosophical spin-off.² A major expositor of *Autopoiesis* in the 21st Century has been **Evan Thompson**, via '*Mind in Life*' (2007).³ Influenced by wider philosophical developments, the general trajectory of the *Autopoiesis* concept over the past 40 years has been away from more *Reductionist* 'Bottom-Up' readings (e.g. the concept of lifeforms being '*Autopoietic Machines*') towards more 'Top Down' approaches incorporating notions of *Emergence* and *Purpose* in Life - *Teleology*.⁴ It will therefore be fruitful, briefly, to place *Autopoiesis* into a *broader philosophical context* to understand this.

The terms '**Top-Down**' (T-D) & '**Bottom-Up**' (B-U) arise from the '*Philosophy of Life*' literature.⁵ Broadly:

T-D understandings admit of *First-Person Agency, Freedom, Meaning, Value, Purpose in Life, Consciousness, Intentionality, Emotion (Love!!), Empathy, Process Thinking, Metaphor, Poetry ...*

B-U understandings use only *Third-Person* verb forms ('It does this') + *Maths, Mechanism, Physical Interactions, and Cause and Effect* - all constrained by *omni-explanatory Physical Laws*.

Extreme B-U approaches are *Reductionist*. Historically, under their influence, philosophers have been guilty of grossly over-simplifying our understandings of Life. Thus, the human brain has been likened to a telephone exchange or a digital computer! From *Artificial Life* studies & the *Sciences of Complexity*, only in recent decades have we learnt that appreciation of *Complexity* is key to any understanding of Life: *Over-simplistic reductionism is dysfunctional*.⁶ *Autopoiesis* recognises that B-U thinking is necessary for understanding life *pragmatically*, but it is far from sufficient, it therefore seeks to reconcile B-U and T-D understandings of life. In fact, *Autopoiesis takes T-D thinking down to the level of single cells!*

¹ Maturana and Varela, '*Autopoiesis and Cognition*' (1980).

² See, e.g., Pier Luigi Luisi, '*Autopoiesis: A Review and Reappraisal*', (2003) and '4EA' (see text below).

³ Other thinkers who have followed up on at least some aspects of the *Autopoietic* tradition are Ezekiel Di Paulo, Andreas Weber, Michel Bitbol, Pier Luigi Luisi, D M Walsh, Andy Clark, and '4EA' theorists of mind (see below).

⁴ Varela himself moved away from an initial concept of *Autopoiesis* that denied *teleology* to a position that *proclaimed* it as explicatory of Life in Weber & Varela (2002), see Thompson (2007): compare p 99 and p. 146.

⁵ *Interface Focus*, 2 (2012), covering the Royal Society meeting on *Top-Down Causation*. Also S I Walker (2012).

⁶ See e.g. Holland, '*Complexity*' (2014).

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We can appreciate some of the differences between B-U and T-D approaches to Life through **Aristotle's 'Four Causes'**: four ways in which we try to understand what something is, or how it has come to be what it is:

Material Cause: *What is it made of?* These days: ask **Physics** or **Chemistry**.

Efficient Cause: *How did it come about?* Our 'Cause and Effect': **Causality**.

Formal Cause: *What Form does it take?* For Life, we temporalize Form to include **Dynamic Process**.

Final Cause: *What is its Purpose? What is its Goal? Its Telos?: What is it For?* **Teleology**.

T-D understandings make use of *all four* of Aristotle's Causes but B-U Reductionist science today insists on the priority of *Material* and *Efficient Causes*. *Formal Causes* (arguably) are regarded as *secondary*: they have pragmatic explanatory power, but they are *themselves* to be explained by *Material* and *Efficient Causes*. e.g. the formal self-wrapping of *proteins* is essential to their biological function, but this is ideally to be understood through their *material* make-up. But Reductionism *vehemently rejects* the *Final Causes* that formerly made science subservient to religion via *Natural Theology*, which posited a *Heteronomous*, *Extrinsic Teleology*: Life existed for the sake of God's Ends. Science must not be in thrall to Religion! However, it is very important for understanding Life to distinguish between *Heteronomous (External)* and natural *Autonomous (Internal)* Teleology: *Externally-Imposed Purposes* (e.g. from God) vs. *Self-Posited Goals*. Autopoiesis adopts *Final Causes* only in the second, *Autonomous*, form.⁷ Note that not all scientists are B-U reductionists!! Many biologists have problems with reductionism, often speaking teleologically of the 'purpose' of bodily organs.

2. The Chief Conceptual Doctrines of Autopoiesis

Self-Making: as described above, *Autopoiesis* recognises that the main activity of organic lifeforms is to generate and regenerate themselves. '*Bluntly stated self-production is already and inevitably a self-affirmation that shows the organism as involved in the fundamental purpose of maintaining its identity*'.⁸

Embodiment: All lifeforms known to science are *Embodied*. *Embodiment* is seen as *central* and *essential* for our understanding of Life. It makes lifeforms *what they are*.⁹ *Embodiment* requires organisms to differentiate 'Self' from 'Other'. But their life is precarious. They have bodily needs and must be *proactive* in attaining them. The maintenance of a body invests organisms with a *concern for* and *interest in* their own well-being. '*A system that has an interest, however, does not experience the world as it is "in objective terms" but according to its needs*'.¹⁰ This is a source of *Meaning in the World*: '*A world without organisms would be a world without meaning*'.¹¹ Note that *Value & Meaning precede* consciousness in *Autopoiesis*. '*Living beings shape the world into meanings ... Sense-making lays a new grid over the world: a ubiquitous scale of value*'.¹²

⁷ For philosophical justifications for accepting *Formal* and *Autonomous Final Causes* in Understandings of Life, see D M Walsh (2012) & (2015), Ch.9 pp. 186-207 and FQXI (2017). See also J Kim (2006) for the *Reductionist* challenge.

⁸ Weber & Varela (2002), p. 116 – note the T-D language.

⁹ This is consistent with the findings of other thinkers: Lakoff & Johnson 'Metaphors We Live By' (2003); Iida et al, 'Embodied Artificial Life' (2004); A Clark, 'Supersizing the Mind' (2008).

¹⁰ A Weber, 'The Book of Desire' (2011) p. 10.

¹¹ Weber & Varela (2002), p. 119.

¹² Thompson (2007), p. 154.

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Cognition: Autopoiesis takes the concept of *Cognition*, normally associated with T-D consciousness, and applies it to all embodied lifeforms. Living beings need to cognise salient features of their surroundings. *Salient* concerns include *the seeking of food* and *the avoidance of threats*. *Cognition is Awareness of the World*.¹³ Most fundamentally, Maturana & Varela tell us that '*Cognition is a biological phenomenon and can only be understood as such; any ... insight into the domain of knowledge requires this understanding*'.¹⁴

The Continuity of Life and Mind: Evan Thompson's main theme in '*Mind in Life*' is the *Continuity of Life and Mind*: '*If Autopoiesis and cognition are what distinguish life from non-life, then the projects of understanding Life and understanding Mind are continuous*'.¹⁵

Phenomenology: Autopoiesis fully encompasses the lived experience that is the focus of T-D Phenomenology. Evan Thompson follows **Husserl** in this.¹⁶ Varela himself (1996) proposed '*Neurophenomenology*', arguing for the need for *First Person* experiences of Life to be studied *dialectically* alongside *Third Person* accounts - he wrote a paper on his own phenomenal experiences of having a liver transplant whilst fully conscious!¹⁷

Enaction: *Living is Performative*.¹⁸ For biological beings all thought & perception must be a form of *action*. Autopoiesis '*Out-Kants*' Kant here! In *The Critique of Pure Reason* Kant insisted that we impose our understandings on the world. The objects we see in the world arise *jointly* from our senses and from the fundamental concepts ('Categories') that we apply to our bare perceptions. But in Autopoiesis we don't just '*project*' our concepts out onto the world - our '*conceptions*' are performative activities. Thus: '*Significance and valence do not exist "out there" but are enacted, brought forth ... by living beings*' ... '*Cognition ... is behaviour or conduct in relation to meaning and norms that the system itself enacts*'.¹⁹

Embeddedness: We are *embedded* in our world and we share it with others: '*... Individual subjectivity is from the outset intersubjectivity, originally engaged and altered by other*' ... furthermore, Life exhibits '*dynamic co-emergence ... part and whole co-emerge and mutually specify each other*'.²⁰ *Mutual Benefit* led single-cell lifeforms to co-operate to generate multi-cellular life-forms like us: *co-evolution*.

Extension: Our *self/other* boundary is actually *permeable* and *difficult to place*. For one thing, we, and other lifeforms, alter our environment to suit ourselves, e.g. we wear clothes and heat buildings: our proximate environment becomes *part of what we are* - as does our circle of friends! Furthermore, we *extend our Mind* beyond our body into our local environment, e.g. when we take notes in a notepad or a smartphone.²¹

Affect: This refers to *Emotions* and *Feelings*. *Emotions* are recognised as essentially *full-body* responses to situations we find ourselves in (e.g. *fear* releases glutamate and adrenaline into our body and we may experience fight/flight responses), whereas *feelings* may manifest as little more

¹³ Thompson (2007), p. 25.

¹⁴ Maturana & Varela (1980), translated from earlier writings 1970 & 72.

¹⁵ Thompson (2007) pp. 127, 157ff.

¹⁶ Thompson (2007), Ch 2, pp. 16-36, p 165 and Appendix A, pp 413-416

¹⁷ Varela, '*Neurophenomenology*' (1996), Varela, *Intimate Distances* (2001), respectively.

¹⁸ *Enaction* was originally posited by Varela, Rosch & Thompson in '*The Embodied Mind*' in 1991.

¹⁹ Thompson (2007), pp. 158, 159

²⁰ Thompson (2007), pp. 36, 38.

²¹ See Clark & Chalmers, '*The Extended Mind*', (1998) and Clark, '*Supersizing the Mind*' (2008).

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than reflective thoughts: we exhibit a whole host of affectual responses of varying degrees of prominence.²²

'4EA': The recognition that Life is **Embodied, Enacted, Embedded, Extended** and **Affective** has led to the coining of the term '4EA' (sometimes just '4E') to summarise these *autopoietic* aspects of life. The notion arose from Varela, Rosch & Thompson's *'The Embodied Mind'* (1991), but it has since taken on a life of its own and has had quite a wide influence on contemporary philosophies of Life.²³

Autopoiesis and Formal Causes. *Autopoiesis promotes Formal Cause as Process: Life Forms are Life Processes.* Matter passes through live bodies at various speeds. It is given *Form* by Life, which generates its own organs from it (*poiesis*), then it breaks it down again & expels it. *Life as Process*, an updated temporalized version of Aristotelian *Form*, manages the matter & makes it subservient to its own ends.²⁴

Autopoiesis and Final Causes (Purposes, Goals, Teleology). Advocates of *Autopoiesis* recognise that it was **Immanuel Kant** who first posited Life as *Self-Organising & Self-Generating* in his *'Critique of Judgement'* (1790).²⁵ Kant proposes: 'A thing exists as a Natural Purpose if it is both cause and effect of itself'.²⁶ Organisms are 'Natural Purposes' according to Kant. *Causality* is circular and self-generated: *Autopoiesis!* – mere '*Efficient Cause*' alone cannot capture these processes.

3. Autopoiesis – Summary and Advocation

Given the Complexity of Life, and given that it must be understood at many different levels in Life's hierarchy – each level having its own appropriate scientific paradigms – it would be unreasonable to expect that the question '*What is Life*' could be answered succinctly! Rather, we should bring all of our resources for understanding forward to the task of getting a viable overview of Life, utilising both *Bottom-Up* (B-U) and *Top-Down* (T-D) approaches. This is what *Autopoiesis* attempts to do via its central doctrines. It is guided by the best contemporary theoretical and empirical science, so we do well to take it seriously. *Autopoiesis* challenges traditional understandings of Life – it takes T-D thinking down to the level of single cells and seeks to *reconcile* B-U and T-D perspectives, but this approach can be commended because it makes the best use of *all human capacities* for understanding. *Autopoiesis* has been developed by open-minded scientists & philosophers working together – both communities can benefit by taking note of it. While few claim to be working specifically on *Autopoiesis*, it has had significant influence, especially through its emphasis on *Embodiment, Enactment* and *Extension*. We may end with a concise thought on what it is that motivates the *Autopoietic* approach to understanding Life, quoting from Rachel Paine: '*If you don't pull the mind, the body, and the world apart, then you don't have to worry about how to put them back together again*'.²⁷

²² Thompson (2007), pp 263-4, 370-8; Mark Johnson, *'The Meaning of the Body'* (2007), esp. Ch. 3, pp 52 ff.

²³ Rachel Paine, '4EA' (2016); Newen et al. (eds.), *'The Oxford Handbook of 4E Cognition'* (2018).

²⁴ See Thompson (2007), pp 79 & 150, Weber & Varela (2002), p. 113.

²⁵ Kant, *'The Critique of Judgement'*, (1790), §61, §62-67, §77.

²⁶ Kant, *Ibid.*, §65; see also Thompson (2007), p. 133 and Weber & Varela (2002), pp. 106 & 121.

²⁷ Rachel Paine, '4EA' (2016).

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