

Autopoiesis and the Complexity of Life

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'Autopoiesis': from ancient Greek: *αὐτο-* ('auto-') meaning 'self' and *ποίησις* ('poiesis') meaning 'creation' or 'production'.

Lifeforms are '**self-generating**' or '**self-producing**'

***Autopoiesis* – Arrangement of the Presentation**

- (1) Introduction: *Autopoiesis* – the basic concept
- (2) A Broader Context: its place among '*Philosophies of Life*'
- (3) ***Autopoiesis* – The Main Doctrines**
- (4) The Complexity of Life
- (5) *Autopoiesis* – Advococation

(1) Autopoiesis as an Account of Life – Introduction - 1

‘Autopoiesis’: derived from ancient Greek: *αὐτο-* (‘auto-’) meaning ‘self’ and *ποίησις* (‘poiesis’) meaning ‘creation’ or ‘production’.

Lifeforms are ‘**self-making**’, ‘**self-generating**’ or ‘**self-producing**’.

‘*Poiesis*’ is the same word we see in ‘poet’ and ‘poetry’: a poet is a ‘maker’

The term ‘**Autopoiesis**’: was coined in 1972 by two Chilean biologists (M & V):

Humberto Maturana (b. 1928)

Francisco Varela (1946-2001)

Autopoets?

Autopoiesis:

**The main activity of all lifeforms from single cells upwards
is self-production & self-preservation**

... though much of the time we are not consciously aware of this continuing effort.

M & V took this fact to be a major prerequisite for any understanding of What Life Is

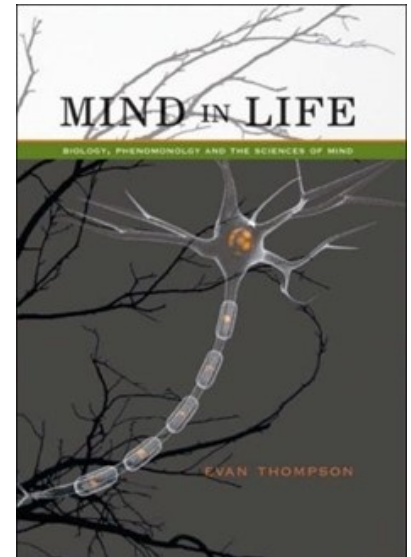
It is the major factor in influencing the cognition and behaviour of all lifeforms.

Autopoiesis as an Account of Life – Introduction - 2

- M & V's first very formal publications on *Autopoiesis* appeared from 1972 to 1980 (see refs).
- The concept has evolved *significantly* since that time.
- Never 'mainstream', it has engendered important scientific and philosophical spin-offs.
- The general trajectory of *Autopoiesis* over 40 years has been away from more *Reductionist* '**Bottom-Up**' readings (e.g. 'Autopoietic Machines') towards more '**Top-Down**' approaches, incorporating notions of *Emergence* and *Purpose* in Life - **Teleology**.

A major expositor of *Autopoiesis* in the 21st C has been **Evan Thompson**, via his book '*Mind in Life*' (2007),

See also the Special Issue on Evan Thompson's '*Mind in Life*',
Journal of Consciousness Studies, **18**, No. 5-6, 2011.



- Other thinkers who have followed up on at least some aspects of the *Autopoietic* tradition are Ezekiel Di Paulo, Andreas Weber, Michel Bitbol, D M Walsh, Andy Clark, Pier Luigi Luisi

Autopoiesis is promoted as a Scientific and Philosophical enterprise, essentially centred on Biology. It attempts to understand The Natural ('Life') in terms of The Natural.

(2) 'Top-Down' (T-D) and 'Bottom-Up' (B-U) Understandings of Life

Levels for Understanding Life

(just one way of conceiving them)

The Biosphere (Gaia?)
Ecological - Inter-Species
Inter-Cultural

↓ 'Top-Down' ↓

Social - Cultural
Personal - Mental
Organic - Metabolic
Molecular, incl. Genetic
Biochemical
Chemical
Physical - Quantum Mechanical

↑ 'Bottom Up' ↑

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

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

Autopoiesis takes T-D understandings down to the level of single cells !!!!

Understanding the T-D – B-U Distinction 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**.

See Aristotle, *Physics*, Bk 2, 3-8.

It is very important to distinguish between **Heteronomous** (External), e.g. God-given Teleology
&
Natural **Autonomous** (Internal) Teleology - **Self-Posited Goals**.

Autopoiesis adopts only the latter.

Formal and Final Causes (*Teleology*) in Biology – 1

Reductionism: only B-U Understandings are valid

Reductionist Science today insists on the priority of **Material & Efficient Causes**.

Formal Causes are seen as important but secondary:
they have pragmatic explanatory power,
but they are themselves explained by *Material* and *Efficient Causes*.

e.g. the formal self-wrapping of **Proteins** is essential to their function,
but this is ideally to be understood through their material make-up.

But **Final Causes**, Purposes or Goals in Life are seen as immature *Superstitions* left behind by scientific progress: **They formerly rendered science subservient to Religion**

But it was Heteronomous Teleology that they were rejecting

Formal and Final Causes (*Teleology*) in Biology – 2

Autopoiesis today rejects Reductionism and seeks to *reconcile* B-U & T-D approaches

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 also Thompson (2007): compare p 99 and p. 146.

*But this is Autonomous Teleology – promoted by lifeforms themselves -
Lifeforms have their own purposes and goals*

Arguments for emancipating & adopting *Autonomous Teleology* can be found in the writings of D M Walsh, e.g. Walsh (2012, 2015).

(3) Autopoiesis in More Detail

The chief conceptual doctrines of *Autopoiesis*, quoting liberally from the *Autopoets*!

Remember: *Autopoiesis* takes T-D thinking down to the level of single cells

1. 'Autopoiesis' = Self-Making:

The main activity of all lifeforms from single cells upwards is
self-production and self-preservation

Lifeforms normally spend the bulk of their energy resources in doing just that.

M & V took acceptance of this fact to be a major prerequisite for any understanding of What Life Is.

It is the major factor in influencing the cognition and behaviour of all lifeforms.

'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'

2. Embodiment:

All Lifeforms known to Science are *Embodied*.

Embodiment makes lifeforms *what they are*.

Embodiment requires organisms to differentiate 'Self' from 'The Other'.

Organisms have bodily needs and must be *proactive* in attaining them. But life is precarious.

The maintenance of a body invests organisms with a concern for their well-being.

'To maintain itself as a definite form in matter the organism manifests a directed tendency, an active interest in its own continuation. A system that has an interest, however, does not experience the world as it is "in objective terms" but according to its needs', A Weber (2011) p. 10.

This is a source of *Meaning* in the World:

'A world without organisms would be a world without meaning', Weber & Varela (2002), p. 119.

Embodied Organisms generate meaning! *Value & Meaning precede consciousness.*

See Iida et al (2004), esp. the *Introduction* by Pfeifer & Iida; Andy Clark, (2008); A Weber, (2011), p. 10.

Weber & Varela (2002), p. 119; Lakoff & Johnson (2003)

3. Cognition:

It takes the concept of *Cognition*, normally associated with T-D consciousness, and applies it to all embodied lifeforms.

Cognition is Awareness of the World. Thompson (2007), p. 25.

Living beings need to cognise **salient** features of their surroundings.
Salient concerns include *the seeking of food* and *the avoidance of threats*.

‘Cognition is a biological phenomenon and can only be understood as such ...’. M & V (1980).

*‘Living systems are cognitive systems, and living as a process is a process of cognition.
This statement is valid for all organisms, with or without a nervous system’.*

See M & V, ‘The Santiago theory of Cognition’, Wiki.

‘Living is a process of cognition’

Thompson (2007), p. 157

4. The Continuity of Life and Mind:

Evan Thompson's main theme in '*Mind in Life*' is the **Continuity of Life and Mind**.

Thompson (2007), p. 157ff

No Cartesian Dualism!: The Mind/Body split cannot exist in *Autopoiesis*.

*'If Autopoiesis and cognition are what distinguish life from non-life,
then the projects of understanding Life and understanding Mind are continuous'.*

Thompson (2007), p. 127

To appreciate the closeness of consciousness and unconscious living, think of ***breathing***.

We normally allow our bodies to control our breathing,
but we can readily draw our Mind's attention to it & control it consciously.

NB. We have had a concept of the *unconscious* mind at least since the time of Freud.

Or we can think of '*mind*' as a verb, actively '*mind*ing' our existence

5. Phenomenology:

Autopoiesis fully encompasses the lived experience that is the focus of T-D Phenomenology.

Evan Thompson follows Husserl in this.

Thompson (2007), Ch 2, pp. 16-36, pp 149, 165 and Appendix A, pp 413-416

Varela himself (1996) proposed '*Neurophenomenology*', arguing for the need for *First Person* experiences of Life to be studied *dialectically* alongside *Third Person* accounts.

Varela, '*Neurophenomenology*' (1996). Thompson (2007), Ch 2, pp. 16-36, p 165 and Appendix A, pp 413-416

Varela wrote a paper on his own phenomenal experiences of having a liver transplant whilst fully conscious! Varela, '*Intimate Distances*' (2001).

6. Enaction:

Living is Performative: For biological beings, all thought & perception must be a form of *action*.

Varela, Rosch & Thompson initially posited the concept of *Enaction* in '*The Embodied Mind*' (1991)

Autopoiesis 'Out-Kants' Kant here! Kant insisted that we impose our conceptual understandings on the world. We parse the world into subjects & objects and impose *causes* upon them.

But, in Autopoiesis we don't just 'project' our concepts out onto the world – our 'conceptions' emerge as performative activities.

Biologically, *perceiving* is sensorimotive – it entails movement – i.e. doing things in the world.

'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'.

Thompson (2007), p. 157-8

'I claim that the living being 'brings forth' or enacts what counts as the living being's world'.

Thompson (2011), p. 203

Active vs. Passive! Not the Berkelian '*Esse est percipi*': 'To be is to be perceived' –
but '*Esse est agere*': 'To be is to do, to act, to strive'!

Froese & Di Paolo, '*The Enactive Approach*', *Pragmatics & Cognition* 19:1 (2011), pp 1–36.

7. *Embeddedness*:

We are *embedded* in our world and we share it with others

... for example, we are embedded in our cultural context:

*'... Individual subjectivity is from the outset intersubjectivity,
originally engaged and altered by others ...*

[it is] culturally embodied, embedded and emergent' Thompson (2007), p. 36.

Socially *' ... self and other enact each other reciprocally through empathy ...'*, *ibid.* p. 36.

Furthermore, Life exhibits:

' ... dynamic co-emergence ...

... part and whole co-emerge and mutually specify each other' *Ibid.* p. 38.

Mutual Benefit led single-cell lifeforms to co-operate
to generate multi-cellular life-forms like us: *co-evolution*.

8. *Extension:*

Our *self/other* boundary is actually *permeable* and *difficult to place*.

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.

Mind goes beyond Body!

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

9. Affect:

This refers to the *Emotions* and *Feelings* we have when we interact with the world:

Emotions are recognised as essentially *full-body* responses to situations we find ourselves in (e.g. *fear* releases glutamate & adrenaline and we may experience fight/flight responses).

Feelings may manifest as no more than reflective thoughts: we exhibit a whole host of affectual responses of varying degrees of prominence.

The emphasis on '*Reason*' and emotion-free '*Impartiality*', in Western philosophy has led to an underplaying of *Affect*, but *Autopoiesis* and other contemporary philosophical movements are making up for this.

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

10. '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)

It has since taken on a life of its own and has had quite a wide influence on contemporary Philosophies of Life.

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

11. Autopoiesis and Formal Causes

Process Thinking: *Life Forms are Life Processes.*

Life as Process manages the matter & makes it subservient to its own ends:

‘Every five days you get a new stomach lining. You get a new liver every two months. Your skin replaces itself every six weeks. Every year 98% of the atoms in your body are replaced’.

Margulis & Sagan, (1995) quoted in Thompson (2007), p. 150.

‘... the particles of matter that make up the organism in each moment are only temporary and passing contents. Their identity does not converge with the identity of the whole through which they pass. But it is exactly by the passing of alien matter as part of itself that the whole maintains its spatial system, the living form. From a material point of view, it is never the same, although it keeps its identity exactly by not keeping the same matter. If it ever will be the same as the sum of its matter it has ceased to live ...’. Hans Jonas, (1973), p. 120, in Weber & Varela (2002), p. 113.

Thus, the Material Cause is subjugated to the Formal Cause

‘Form so understood, “is no more composed of parts which can be distinguished in it than a melody (always transposable) is made of the particular notes which are its momentary expression”’.

Merleau-Ponty (1963) p. 137, quoted in Thompson (2007), p. 79.

12. Autopoiesis and Final Causes (Purposes, Goals, Teleology).

Promoters of Autopoiesis recognise that it was **Immanuel Kant** who first posited Life as **Self-Organising & Self-Generating** in his 'Critique of Judgement', Pt. 2 (1790).

Kant: in lifeforms ...

'... the parts ... combine into the unity of the whole because they are reciprocally cause and effect of their form' ... 'A thing exists as a Natural Purpose if it is both cause and effect of itself'.

Kant, 'The Critique of Judgement' (1790), §61-67, §77, also Thompson (2007), p. 133-4.

Organisms are 'Natural Purposes' according to Kant.

'... it was Kant who elaborated for the first time the similarity of this intrinsic teleology with a modern understanding of self-organization'. Weber & Varela (2002), p. 106.

Mere 'Efficient Cause' alone cannot capture Life's processes.

Note also that the *Foundational Questions Institute (FQXI)*, recently ran an essay competition (2017) on how *Purpose* can emerge in a physical world: <http://fqxi.org/community/contest>.

(4) The Complexity of Life

The Philosophy of Life has been plagued by over-simplistic accounts – Life is Complex!!

Life's complexity is exemplified by the sheer diversity of the gene pool in the biosphere, unlike physics - the simple science - where, e.g. every electron is identical. That cannot be said of people, or dogs!

Genomes and *Paris Japonica*

- The human genome contains roughly 3.2 billion base pairs, ~ 800 MB of stored data
- *Paris Japonica* has a genome of 150 billion base pairs or 37.5 GB of data, from S I Walker (2012)



Complexity of the Immune System

' ... because of its vast combinatorial diversity, the immune system rapidly generates a large number of different types of antibodies (for a typical mammal it is on the order of 10^7 to 10^8) capable of recognizing an even larger number of foreign molecules (estimates range as high as 10^{16})'.

John Johnson (2008) p. 206

(5) Advocation of Autopoiesis - 1

Accounts of Life that do not recognize its **complexity** are not doing their job

Autopoiesis through its 4EA perspective, especially via *Embodiment*, fully encompasses and accommodates Life's complexity.

Autopoiesis promotes a perspective on Life that is sufficiently flexible to incorporate new scientific findings.

It is guided by the best contemporary theoretical and empirical science

e.g. The Rise of Epigenetics,

Neurophysiology

Information Theory

New findings on Darwinian Evolution beyond the 'Modern Synthesis'

Advocation of Autopoiesis - 2

Levels for Understanding Life

(just one way of conceiving them)

The Biosphere (Gaia?)
Ecological - Inter-Species
Inter-Cultural

↓ 'Top-Down' ↓

Social - Cultural
Personal - Mental
Organic - Metabolic
Molecular, incl. Genetic
Biochemical
Chemical

Physical - Quantum Mechanical

↑ 'Bottom Up' ↑

Pragmatically, Life must be understood by scientists at many different levels in its hierarchy – each level having its own scientific paradigms and perspectives.

Can we really expect that scientific specialists from each of these different levels could all agree on a single answer to the question 'What is Life'?

Humberto Maturana: *'Sometimes people ask me, "what is your definition of life?" To accept this question is always a mistake because life and living are not to be defined'*. Maturana (2011), p. 146.

Rather, we should bring all of our human resources for understanding forward to the task of getting a viable overview of Life, utilising both B-U and T-D meta-paradigms: **Autopoiesis**.

Advocation of Autopoiesis - 3

- *Autopoiesis* has been developed by open-minded scientists & philosophers working together - it is neither 'scientific' nor 'ivory tower'

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*. The notion of the '4EA' mind is a spin-off that has become a 'school' in its own right.

See Newen *et al*, (2018).

Finally: Advocation of Autopoiesis – 4

We can perhaps proffer a concise thought on what it is that motivates the *Autopoietic* '4EA' approach to understanding Life:

Continuity of Thought: Wherever Nature herself exhibits only continuity we should *remove* the barriers that our own concepts impose upon Nature in our attempts to understand Life ...

... or – 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'.

Rachel Paine, '4EA' (2016).

Discussion

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