The Chain Without the Ring

What sterile soil shows about life, read through the Vacuum.Net Theory

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Abstract

A French group sterilised soil with gamma rays. The soil kept taking up oxygen and giving off carbon dioxide for more than six years. No living cell was found. The group calls this non-living respiration. It also finds most intermediates of the Krebs cycle in the dead soil. But the cycle does not close. Oxaloacetate piles up. Citrate is missing. The authors call this a dead end.

This essay reads the dead end as the key result. In the Vacuum.Net Theory, life is a closure that closes on its own making. The soil runs the chain of the cycle, but not the ring. The cell is the depth that closes the ring. We place the soil data on the depth ladder of the theory. Three results follow. A clay particle sits at the same length depth as a bacterium. An enzyme sits at the same time-minus-length depth as a ribosome. The soil process sits far above the living band in time. From this we set out what could be possible: a measurable definition of life, a way to close the ring outside the cell, a new reading of soil carbon, and a new view of the origin of life. Each comes with a test.

1. The finding

Sébastien Fontaine wanted a baseline. How much carbon does soil release when nothing lives in it? His team sealed soil in jars and sterilised it with gamma rays. They expected the carbon dioxide to stop. It did not stop [10].

The work began with a paper in 2013 [6]. It ended, for now, with a paper in Science Advances in 2025 [1] and a preprint on the Krebs cycle [2]. The soil came from Theix in the Massif Central. It was sterilised at 45 kGy. Sterility was checked with live/dead staining, flow cytometry, culture plates, broth and electron microscopy. No viable cells were found [1].

The main numbers are these [1]:

- At the start, the sterile soil gave off 63% of the carbon dioxide of living soil. After 163 days this settled at 17%.
- Oxygen was taken up together with the release of carbon dioxide.
- Emission lasted 2442 days, about 6.7 years. Between year 4 and year 6 it fell by only 1.5 to 4.9% per year.
- Added glucose raised the emission only after about four years.
- In a soil fuel cell, pyruvate gave a current within 20 minutes. It peaked at 35 µA on day 3. It fell when the pyruvate ran out. A second dose on day 77 brought it back.
- Two processes fit the data. A fast one with a half-life of about 71 days. A slow one with a half-life of about 7 years, or no decline at all.

2. What the authors want to show

The authors make three claims. First, soil particles can pass electrons from organic matter to oxygen without a cell. Second, this lasts for years, longer than any known enzyme. They therefore point to minerals such as iron and manganese oxides. Third, parts of the Krebs cycle form by themselves in dead soil [1, 2].

From this they draw two conclusions. Soil carbon models must include a non-cellular part. And metabolism may be older than the cell [1, 10]. This fits earlier work on metabolism without enzymes. Iron alone can drive a network that overlaps the Krebs cycle [4, 5]. A reconstructed early ocean can drive reactions of glycolysis [3].

3. The dead end

The preprint measured seven intermediates [2]. In the living soil none were found. In the sterile soil six of the seven were found. Only citrate was missing in most treatments.

Oxaloacetate dominated. After 163 days it reached 49.6 µg per gram in citrate-treated soil. That is 25 to 130 times the other intermediates. Labelled carbon showed the route. Citrate and glucose fed into succinate, fumarate and oxaloacetate [2].

So the chain runs from citrate down to oxaloacetate. Then it stops. The step that closes the cycle is oxaloacetate plus an acetyl group back to citrate. The authors note that this step has never been reproduced without enzymes. They call the result a dead end [2].

This is the central fact of the essay. The soil has the chain of the Krebs cycle. It does not have the ring.

4. Life as closure

The Vacuum.Net Theory starts from one distinction: motion that returns. A return is a closure. Windings in windings give depths. A body is a depth. Life is a distinct kind of closure: one that closes on its own making [9]. This agrees with Rosen, who defines life as closure to efficient causation [12]. It agrees with Maturana and Varela, who call the organism autopoietic: it makes the parts that make it [13].

Read this way, the soil result is exact. The chain is present. The return is absent. A process that does not return only runs down. It runs down to carbon dioxide. That is what the jars show for six years.

The cell, then, is not the place where the chemistry happens. The chemistry happens without it. The cell is the depth that makes the chain return to its start. It closes the ring.

5. The soil on the depth ladder

5.1 Method

A depth is a factor of three. The depth of a concept is the logarithm, base three, of a ratio. Depth zero is the hydrogen atom: the Bohr radius in length and its orbital period in time [9]. The time unit equals Larson's natural unit of time within 0.05% [8, 9]. Sizes and times of cells come from standard tables [14].

5.2 Length

Concept	Size	Depth
Water molecule	0.28 nm	1.5
Glucose, Krebs intermediate	~0.7 nm	2.4
Enzyme	~5 nm	4.1
Iron oxide nanoparticle	10 nm	4.8
Iron oxide particle	100 nm	6.9
Clay particle (upper limit)	2 µm	9.6
Bacterium (E. coli)	2 µm	9.6
Human cell	10 µm	11.1
Soil aggregate	0.25–2 mm	14.0–15.9

Table 1. Length depths. Depth 0 is the Bohr radius.

5.3 Time

Event	Time	Depth
Enzyme turnover (10–1000 per s)	1 ms–0.1 s	26.9–31.1
Fuel cell current starts	20 min	39.6
Bacterial division	20 min	39.6
Fuel cell current peaks	3 days	44.5
Fast soil process, half-life	71 days	47.4
Year	1 year	48.9
Glucose effect appears	~4 years	50.1
Slow soil process, half-life	~7 years	50.6
Duration of the experiment	2442 days	50.6

Table 2. Time depths. Depth 0 is the orbital period of the hydrogen atom.

5.4 Time minus length

For a closure with its own cycle, time depth minus length depth counts how many returns one cycle holds, compared with the atom. In One Distinction three bands appear [9]. Atoms and molecules sit at 0 to 2. Celestial bodies sit at 4 to 8. Living closures sit at 12 to 32.

Closure	Length	Time	Time − length
Hydrogen atom	0.0	0.0	0.0
Ribosome [9]	5.6	30.4	24.8
Enzyme turnover	4.1	29.0	24.8
Bacterium [9]	9.6	39.6	30.0
Human cell [9]	11.1	43.5	32.4
Human body [9]	22.0	34.4	12.4
Soil process, fast	4.8	47.4	42.6
Soil process, slow	4.8	50.6	45.9

Table 3. Time minus length. Rows marked [9] are taken from One Distinction, Chapter 15.

5.5 What the ladder shows

- **Same size, other time.** The enzyme and the mineral particle sit at the same length depth, 4 to 5. In time they lie 18 to 22 depths apart. What separates the cell from the soil is not size. It is the rate of return.
- **The enzyme sits with the ribosome.** Its time minus length is 24.8, the same value as the ribosome. Inside the cell, the catalyst returns at the depth of the living band.
- **The soil sits above the living band.** Its values of 43 to 46 lie above the band of 12 to 32. A half-life is a running down, not a return. The soil process has no own cycle. It is a chain, and the ladder shows it.
- **The clay particle has the size of the bacterium.** Both sit at 9.6. The particle that now carries the chain has the size of the cell that is gone.
- **The current starts at the depth of a division.** The fuel cell responds at 39.6, the time depth of a bacterial division.

- **Two processes, two depths.** The fast and slow processes lie 3.3 depths apart, a ratio of 36. The slow process coincides with the length of the experiment. That is why the authors cannot tell a seven-year half-life from no decline. The experiment measures the slow process at the edge of its window.

6. What could be possible

If life is the ring and not the chain, several things become possible. Each follows from the reading above. Each can be tested.

6.1 A definition of life that can be measured

Life is then not a list of properties. It is a closure with its own returning cycle, at a time-minus-length depth inside the living band. Chemistry alone gives the chain. A return gives the ring. The test is simple: look for a cycle that comes back, and place it on the ladder. This also answers Bouquet's remark that we cannot always tell living from non-living, even in ordinary soil [10]. The question is not what substances are present. The question is whether anything returns.

6.2 Closing the ring outside the cell

The soil lacks one step: oxaloacetate plus acetyl back to citrate. If the ring is what makes life, then supplying that step should change the soil. Add an acetyl donor, or a mineral surface that joins the two. Then citrate should appear. Oxaloacetate should stop piling up. And a cycle should appear in the data: a signal that returns instead of only running down. On the ladder, time minus length should fall from about 45 into the living band. That would be a ring without a cell.

6.3 The fuel cell as a probe of return

The fuel cell already shows a response that comes back when the substrate comes back [1]. Dose it at regular intervals. Then vary the interval. If the soil has a preferred return, the current will lock onto it. If it has none, the current will only follow the dose. This separates chain from ring with one instrument.

6.4 Soil carbon read again

About a sixth of soil carbon dioxide came from the non-cellular part after the first months [1]. Earlier work found 16 to 48% [6]. In soil carbon models this part is now absent. It does not depend on microbes. It does not stop when microbes stop. A model that follows depths would treat it as its own winding, with its own slow return. It also means soil is never simply dead. Its lower depths keep running.

6.5 The origin of life without a beginning

The question "how did life begin" assumes a start. In the theory there is motion that returns, and depths that add [9]. The soil shows the depth below the cell: the chain, carried by particles of cell size. Iron networks show the same chain without oxygen [4, 5]. The cell is then the depth that closed the ring. It did not invent the chemistry. It took the place of the particle and made the chain return.

6.6 Looking for life elsewhere

If life is a ring, the search for life on other worlds changes. Finding Krebs intermediates proves nothing. The soil has them. What counts is a cycle that returns at the right depth. This is a measurement of time, not of chemistry.

7. The language that hid the result

For more than ten years the signal was treated as an error. Colleagues advised Fontaine to move on. Reviewers doubted the sterility [10]. The reason lies in the words. Respiration was seen as cell bioenergetics [1]. It was held to be strictly inside the cell, because respiratory enzymes are fragile [7]. The popular account speaks of reactions that release the energy of sugar and power life [10].

This is the language of the steam engine. The cell is a furnace. Sugar is fuel. Respiration burns it. In that language, burning without a furnace is impossible, so the data must be wrong. In the language of closure,

nothing is impossible here. The chain runs where it can. The ring needs a further depth. The soil shows the difference, once the words allow it.

8. Conclusion

Sterile soil keeps running the chain of the Krebs cycle for years. It does not close the ring. On the depth ladder, the mineral catalyst has the size of an enzyme, but its time lies far above the living band. The enzyme, inside the cell, sits with the ribosome. The clay particle sits with the bacterium.

The result supports a plain statement. Life is not the chemistry. Life is the ring that closes on its own making. The cell is the depth that closes it. What could be possible follows from that: a definition of life that can be measured, a ring closed outside the cell, a soil carbon model with a lower winding, and an origin of life without a start.

Annotated references

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