

Opinion Paper

Cycles and Overlaid Cycles in the Environment Their Possible Help in the Creation of Complex Metabolism and Life

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Preface

Issue 2.2018 of the German magazine "MaxPlanck-Forschung" has the main topic "Origin of Life". Scientists are quoted that certain cyclic processes in the (global or local) environment may help or have helped in the creation of complex molecules (translation of the quotes from German to English by IA):

- „The **cycles** in which low ponds first dry out and then are filled with water again, may favor the creation of longer RNA-chains.“ (p.22, T. Henning, MPIA Heidelberg)
- „These experiments give hints that some type of engine is necessary to propel the reaction: the natural light-dark-**rhythm** of day and night.“ (p.24, O. Trapp, LMU Munich)
- Repeated freezing and defrosting of salty solutions (p.30, H. Mutschler, MPI Biochemistry)

Various Cycles in the Environment

* **Day and Night** on a planet which orbits some star without bounded rotation.
(Specialty: at sunrise and sunset on planets with atmosphere there may be short phases with different wavelength mixes.)

* **Seasons**: either at tilted planets (like Earth) or at planets/comets on elliptic trajectories. Perhaps highly elliptic comet orbits (with their expressed seasons) help with rapid creation of complex (organic) molecules in and on the comets.

* **Tides (ebb and flow)** (in 3-body-systems like Sun/Earth/Moon or more generally star/planet/large moon)

If the surface of the planet has boundary regions between land and sea, the waves may bring energy in local layered systems. Example: the **Mica sheets** with their narrow mineral layers and interstices investigated by Helen Hansma (in her model with primordial sandwiches instead of primordial soup or primordial pizza).

* Rhythmic activities of **Geothermics** (Example: Geysir Old Faithful in the Yellowstone National Park).

* On a very large scale: changes between **warm times and cold times** (Milankovic-Cycles, which lead/led to ice ages on Earth).

Overlaid Cycles

In some scenarios it may help (or more generally: play a positive or negative role), if various cycles overlay each other. Examples:

* day/night and geothermics

* day/night and seasons

* day/night and tides

* day/night and tides and geothermics

Here it may make a difference, if two or more cycles are in some simple **resonance** or not.

Pseudo-Cycles

Sometimes, events have a cyclic structure in short terms, which is however broken over and over again. Examples:

* Global dust storms on Mars (about every three Martian years, but it does not always fit exactly)

* Sunspots (indicating activities in the Sun; one round takes between 10 and 12 earth years)

* Periodic or quasi-periodic central stars

* Volcanism

* Red spots on Jupiter (appearing and disappearing on timescales of centuries or millennia) 3

Random Fluctuations

- * Clouds in motion
- * Single (heavy) planet quakes
- * Single massive volcanic eruptions (based on typically non-cyclic plate-tectonics) and their "global" consequences on the climate

Such fluctuations and single events may help to find ways out of "metabolic dead ends".
(Comment by Richard Lorentz: I like this path of thought!)

Theses / Philosophy

- * **Without environmental rhythms no complex Chemistry, or:
Dynamics with regular changes help in the creation of complex molecules.**
- * **Life is rhythm, or the other way round "Without Rhythm no life".**

Feedback – from all disciplines - is welcome!

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References

Issue 2.2018 of „MaxPlanck-Forschung“, online available at
https://www.mpg.de/12114865/MPF_2018_2.pdf

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https://www.nsf.gov/news/news_summ.jsp?cntn_id=117405