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A very universal biomarker: Life = Order + Complexity

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Terrestrial life is characterized by significant complexity combined with a high degree of order. Life needs complexity and order combined to develop functionality, exactly this functionality that life uses to keep up its ordered state against the second law of thermodynamics. Essentially, life is a form of **self-sustaining complex order**. Consequently, the combination of complexity and order qualifies as a very general biomarker. All known life on Earth fits into a section defined by typical thresholds for complexity and order. The opposite is true as well: everything on Earth that fits into this section is either life itself or something that has been produced by life.

In the lab as well as in nature, it is quite easy to achieve order without complexity. Any crystallization process leads to states of high order. However, due to missing complexity, crystals have practically no functionality. Likewise, it is quite easy to achieve complexity without order. A random polymerization process may lead to copolymers of high complexity. However, due to missing sequential order, such random polymerization products have practically no functionality.

The most powerful process that leads to complexity combined with order is evolution. At a very early stage, molecular evolution leads to polymer chains of increasing complexity (defined by the length of the chain sequence) and increasing order (defined by the reliability and variability of the sequence). As an example, such a process is calculated based on a simplified RNA world model. The resulting data show the potential of the RNA evolution to reach states of high complexity and order.

References

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