

A Formal Microlectic Framework for Biological Circularity

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Abstract : "Circularity" is supposed to be an adjustable formal framework with enough expressive power to articulate biological theory about Earthly Life in the sense of multi-scale biological autonomy constrained by non-equilibrium thermodynamics. "Formal framework" means specifically a multi-sorted first-order-theory with equality (for each sort). Philosophically, such a theory is one kind of "microlect," which means a "way of speaking" (or, more generally, a "way of behaving") for overtly expressing a "mental model" of some "referent." Other kinds of microlect include "natural microlect," "diagrammatic microlect," and "behavioral microlect," with examples such as "political theory," "Euclidean geometry," and "dance choreography," respectively. These are all describable in terms of a vocabulary conforming to grammar. As aspects of human culture, they are possibly reminiscent of Ernst Cassirer's idea of "symbolic form;" as vocabularies, they are akin to Richard Rorty's idea of "final vocabulary" for expressing a mental model of one's life. A formal microlect is presented by stipulating sorts, variables, calculations, predicates, and postulates. Calculations (a.k.a., "terms") may be composed to form more complicated calculations; predicates (a.k.a., "relations") may be logically combined to form more complicated predicates; and statements (a.k.a., "sentences") are grammatically correct expressions which are true or false. Conclusions are statements derived using logical rules of deduction from postulates, other assumed statements, or previously derived conclusions. A circularity is a formal microlect constituted by two or more sub-microlects, each with its distinct stipulations of sorts, variables, calculations, predicates, and postulates. Within a sub-microlect some postulates or conclusions are equations which are statements that declare equality of specified calculations. An equational bond between an equation in one sub-microlect and an equation in either the same sub-microlect or in another sub-microlect is a predicate that declares equality of symbols occurring in a side of one equation with symbols occurring in a side of the other equation. Briefly, a circularity is a network of equational bonds between sub-microlects. A circularity is solvable if there exist solutions for all equations that satisfy all equational bonds. If a circularity is not solvable, then a challenge would be to discover the obstruction to solvability and then conjecture what adjustments might remove the obstruction. Adjustment means changes in stipulated ingredients (sorts, etc.) of sub-microlects, or changes in equational bonds between sub-microlects, or introduction of new sub-microlects and new equational bonds. A circularity is modular insofar as each sub-microlect is a node in a network of equation bonds. Solvability of a circularity may be conjectured. Efforts to prove solvability may be thwarted by a counter-example or may lead to the construction of a solution. An automated theorem-proof assistant would likely be necessary for investigating a substantial circularity, such as one purported to represent Earthly Life. Such investigations (chains of statements) would be concurrent with and no substitute for simulations (chains of numbers).

Keywords : autonomy, first-order theory, mathematics, thermodynamics

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