Water, RNA, and the Essence of Life

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What is the essential quality of being alive? This is the fundamental question of biology that is still unresolved. Many theories have been proposed, most of which boil down to either a replication and ribonucleic acid (RNA) paradigm, or a persistence and protein paradigm. In effect these two ends of the spectrum attempt to resolve a "Which came first?" paradox, replicative systems that persist or persistant structures that replicate.

Much has been discovered using these two guiding paradigms, but the intrinsic abundance and necessity of water in the living state remains an afterthought. The current trend towards genomic understanding of all the molecular 'parts' of the cell openly dismisses water as an integral component. As Albert Szent Gyorgi presciently commented in 1956, "...it looks as if we would soon know everything and understand nothing...This suggests that some very basic information is missing."

I will discuss an alternative paradigm centered around water and translation. The ribosome has been relegated to the status of an 'organelle' by most cell biologists, just another part of an integrated and complex whole. This subjugation has mistakenly rendered the ribosomal structures, and the translation process, as largely passive bystanders in the more important behaviors of life. However, much like water, the pool of ribosomes and extended translation systems form dominant macromolecular structures inside all cells. My attempt to reconcile these two drivers of cell behavior will show the dynamics of translation while harnessing the spatially structured, electrically active properties of water.

On the grandest timeline, translation sets the stage for evolution. Evolutionary theory focuses on replication, however the endless creative variation produced by translation offers a radically more diverse manner to expand the heritable variation that is the substrate for selection. Peptide-water coascervates and hydrogels mimic many behaviors typically associated with living organisms. Therefore, any disspative system with the ability to direct peptide synthesis may be sufficient to support the living state.