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Whence the demise and fall of the RNA World?

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A widely promulgated concept for the fundamental ancestor-descendent relationship at life's origin, and thus the onset of Darwinian evolution, is the RNA World hypothesis. If Darwinian evolution on Earth began with a simple RNA molecule which had the ability to replicate itself, in the long run this must have given way to DNA perhaps via an intermediate RNA(±Peptide) World. This could happen once DNA appeared and became the preferred informational molecule for all extant biology. Yet, making sense of this transition is confounded both by the intervening 4 billion years of biological evolution, and a scarce ancient (pre-3.2 Gyr) geologic record. Here, we explore whether the relative instability of RNA to thermal stresses, salt content, pH, variable UV sensitivity and an overall narrow available suite of metabolic styles, strictly limited the range of suitable habitats for RNA World organisms; they were susceptible to marginalization, assimilation and effective extinction. We propose that main factors responsible for the transition from the RNA±Peptide to DNA+Peptide World included (i) overall changes in the geosphere (e.g. heat flow, crustal type, nutrient availability); (ii) transient global heating of the hydrosphere by late accretion bombardment viz. "thermal bottlenecks"; and, (iii) competition from, and perhaps predation by, metabolically diverse and genomically nimble emergent DNA+Peptide organisms.