The Emergence of a Dynamic Ribosome Likely Terminates Any Remaining RNA World.

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The modern translation machinery was largely established by the time of LUCA. Thus, its origins and evolution provide insight to even earlier time periods [1]. If an RNA World ever existed it would soon be terminated by an increasingly efficient ribosome. The modern ribosome is a dynamic nanomachine driven by co-factors that utilize GTP. However, the co-factors primarily provide efficiency as the system is at its core is a Brownian machine [2]. When and how did the ribosome transition from this primitive version to the modern dynamic system? The usual view is likely that the primary motion is associated with the tRNA. A jkey element in the process is the tRNA, which assumes different orientations at a hinge point that allow it to initially enter the A-site, move to the P-site and ultimately leave the ribosome from the E-site [3]. By comparing high resolution structures before and after movement, we have identified the location of 21 additional pivot points in the large rRNAs. Although many of these pivots have been individually identified and discussed previously, the overall picture was not clear. To address this, we have developed the outlines of a network of motions that likely proceed as a cascade in both a forward or reverse direction as the tRNA progresses from site to site. The tRNA is a central element in the process. However, the earliest tRNA was likely much smaller than the modern version and the segment containing the hinge is in fact not in the oldest part of the tRNA. The modern ribosomal RNAs are quite large and clearly must have grown from smaller versions. In previous work the relative age of many helical regions could be deduced [4]. We hypothesize here that the oldest regions of the small subunit rRNA are inherently mobile and it is this original motion may have been harnessed when the full length tRNA became available. The potential origins of the core synthetic process itself will also be discussed [5].

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