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Host Phylogeny and Viral Genome Size suggest that Viruses may be Antique, but not Primitive

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It has been suggested that RNA viruses and viroids are relicts from an ancient RNA/protein World because of their small-genome sizes and their manifold replication strategies[1]. At the other extreme are the giant DNA viruses which have been grouped by some authors into a fourth domain of life[2]. However, the chemical nature of genomes and other biological data like host-cell dependence for replication reveal another explanation for the early evolution of viruses. In the present work, we compared all biological data of viruses such as chemical nature, genome size, segmentation, and host type. We retrieved, organized, compared, and analyzed all biological data of viruses from GenBank, ICTV, and ViralZone platforms up to December, 2016. We found that viruses with larger and smaller genomes mainly infect eukaryotes. DNA viruses have a more genome-size diversity in all three domains of life. RNA-virus genomes can be larger than ssDNA genomes. Some families of RNA viruses can infect phylogenetically-distant hosts. Retroviruses only infect plants and vertebrates (some prokaryotes have retrotransposons, but these are not wrapped in a protein coat). The 96% of viral RNA families infect eukaryotes. The only prokaryotes which are infected by RNA viruses belong to the Proteobacteria which it is phylogenetically-related to eukaryotes. Moreover, most of the segmented and the most of largest genomes (on average) belong to RNA viruses that infect either plants or animals. The chemical nature and sizes of the viral genomes do not reveal any obvious correlation with the phylogenetic history of their hosts. Accordingly, it is somewhat difficult to reconcile the proposal of the putative pre-DNA antiquity of RNA viruses and viroids, with their extraordinary diversity in plant hosts and their apparent absence among the Archaea. This suggests that viruses could be antique, but not primitive.

[1] Koonin EV and Dolja VV (2013). *Current Opinion in Virology* 3:546-557. [2] Colson *et al* (2012). *Intervirology* 55:321-332.