

Procapsids Built Around Portal and Scaffolding Proteins as a Key Invention in the Evolution of dsDNA Viruses.

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When the first electron micrographs of T4 were published, they did not inspire confidence as a general structural model for dsDNA viruses. However, the ability to isolate conditional lethal mutations, amber and ts, catapulted T4 and other DNA phages into a leading experimental role (Edgar, 1966). One outcome was the discovery –surprising at the time- that virion assembly proceeded through construction of a procapsid empty of DNA, but containing scaffolding subunits, which was subsequently filled with DNA. Consideration of intracellular particles from Adenovirus and Herpesvirus infection suggested that this was a general pathway. This viewpoint was behind the founding of this conference, which attempted to breach the prokaryotic/eukaryotic barrier. In the subsequent decades this general model turned out to be roughly correct, and was further supported by the discovery of a portal complex in Herpes and Adenovirus. Meanwhile environmental microbiologists were isolating and characterizing phages that infected photosynthetic cyanobacteria, the base of the food chain in the world's oceans. Photosynthetic cyanobacteria were thriving long before the emergence of animals and of their enteric bacteria. The phages of cyanobacteria are therefore likely to represent a dsDNA viral lineage with the earliest ancestors. Cyanophage Syn5 is a dsDNA phage propagating in the laboratory on Syn WH8109 from the Sargasso Sea (Pope et al, 2007). The genome has a portal-scaffolding-capsid gene complex as do most dsDNA phage. Recent experiments reveal the intracellular formation of procapsids containing portal and scaffolding proteins, but lacking DNA (Desislava Raytcheva and Jacqueline Piret, unpublished). These results suggest that the evolution of the procapsid complex built around a portal and scaffolding was a very early step in the evolution of all dsDNA viruses.

Edgar, R. S. (1966) "Conditional Lethals" in *Phage and the Origins of Molecular Biology*, (Edited by J. Cairns, G. S. Stent & J.D. Watson) Cold Spring Harbor Press, NY.

Pope, W.H., Weigele, P.R., Chang, J., Pedulla, M.L., Ford, M.E., Houtz, J.M., Jiang, W., Chiu, W., Hatfull, G.F., Hendrix, R.W., and King, J. (2007) [Genome sequence, structural proteins and capsid organization of the Cyanophage Syn5: A "Horned" bacteriophage of marine *Synechococcus*](#). *J. Mol. Biol.*, **368**, 966-981.