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Chlamydial evolution probed

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The last common ancestor of the Chlamydiales group of bacteria lived about 700 million years ago inside a eukaryotic host cell, according to a new study. This primeval chlamydia encoded many virulence factors now found in modern pathogenic chlamydiae as well as in *Salmonella* and *Escherichia coli,* according to the authors of the paper in Science published on April 8, 2004.

Matthias Horn and colleagues at the University of Vienna used the genome sequence of the group's recently discovered closest living relative - an endosymbiotic chlamydia living in amoebae - to reconstruct the genetic makeup of the last common ancestor. Among the species' virulence factors, now found in a wide range of bacterial pathogens, was a type III secretion system - a mechanism by which bacteria can inject their proteins into host cells in order to force the host cells do something to the bacteria's advantage.

Horn showed that the sequence of the symbiotic chlamydia had to be close to the ancient sequence. "We could see that the genome was stable for many [millions of years because] we didn't see any evidence for horizontal gene transfer," he told us.

The team discovered that, compared with the pathogenic chlamydiae, certain metabolic pathways, such as those required for the production of certain amino acids or vitamins, are still missing in the symbiont. "They need to get them from the host, so we can argue that this organism has had to live within a eukaryotic host cell for many years," Horn said.

Calculating the divergence of these symbionts from pathogenic chlamydiae by mathematical modeling allowed the team to determine that the last common ancestor of these two organisms lived during the Precambrian age, when the first eukaryotes were starting to evolve. "We could show that they have been living within eukaryotic cells for hundreds of millions of years, and the basic mechanisms to survive within eukaryotic cells obviously were developed in ancient times long before animals or plants occurred on planet Earth," Horn said.

Amoebae have been considered a kind of "biological gymnasium" in which originally free-living bacteria acquire the necessary fitness to become intracellular bacterial pathogens, according to Michael E. Ward, professor at Southampton University School of Medicine. "The sequence gives an insight into how intracellular pathogens may have evolved and how future emerging bacterial pathogens from amoebae might arise."

The authors of the paper suggest that their observations of symbiosis of chlamydia in amoebae could bolster the theory that eukaryotic cells acquired mitochondria or chloroplasts early on in evolution by capturing cyanobacteria. However, Radhey S. Gupta, professor of biochemistry at McMasters University, who was not involved in the study, said that "chlamydiae are very different from cyanobacteria, and the little similarity that is seen in a small number of genes probably can be explained by other means than common ancestry of these two groups."

Symbiotic chlamydiae could be a potential source of new pathogenic organisms, according to Gupta. However, since the organisms have been in the environment for a long time, he said, it is not likely that they would pose any kind of a new threat that was not there previously.

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