

Is there a place for bacteriophages in diagnosis and treatment of Lyme Disease?

Jinyu Shan¹ (js401@le.ac.uk), Louis Teulieres², and Martha Clokie¹
¹Department of Infection, Immunity, and Inflammation, University of Leicester, LE1 6RH, UK
²Neurological disabilities Center, Fondation A De Gaulle, Versailles, 78000, France

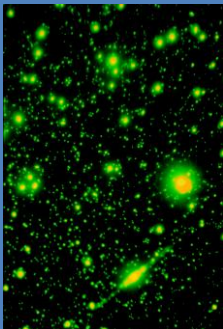


PHELIX RESEARCH AND DEVELOPMENT

Alternatives to treatment of Lyme disease are needed

- Although no evidence of antibiotic resistance to *Borrelia* has been reported to date, multiple observations have given cause for the concern regarding the ability of antibiotics to completely eradicate *Borrelia* in an infection setting.
- To avoid a future of 'post-antibiotic era' and to improve current treatments, there is a need for alternatives to treat Lyme disease, and one such approach is bacteriophage (phage) therapy.

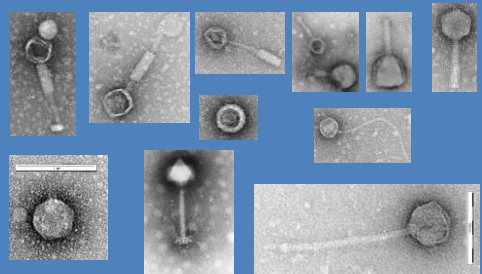
Bacteriophages (phages) are viruses that infect bacteria, and they are everywhere



50 million (5×10^7) viruses per milliliter of seawater
 Estimated number of phages:
 The open ocean: 1.2×10^{29}
 The soil: 2.6×10^{29}
 The ocean sediments: 3.5×10^{30}
 The terrestrial sub-surfaces: $0.25 - 2.5 \times 10^{30}$
 If phages were the size of a beetle, they would cover the Earth and be many miles deep

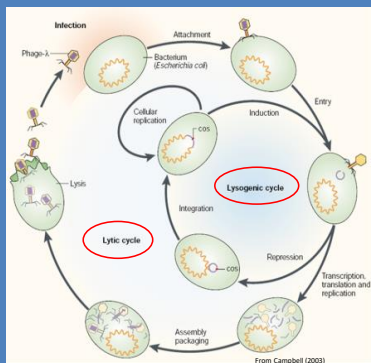
Fluorescence imaging of marine viruses (Fuhrman J.A. 1999)

What phages look like?

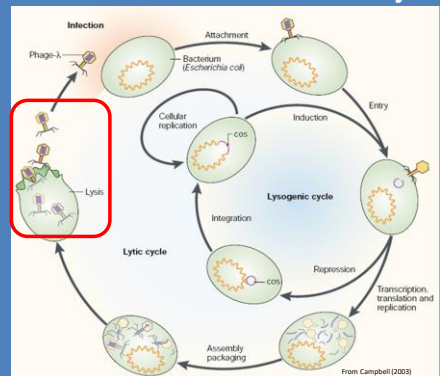


Phage images taken by transmission electron microscope (TEM) under a magnification of around 100,000

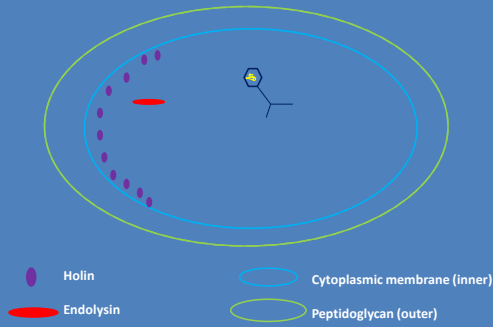
Life cycle: Lytic and Lysogenic



How to break out of the bacterial jail?

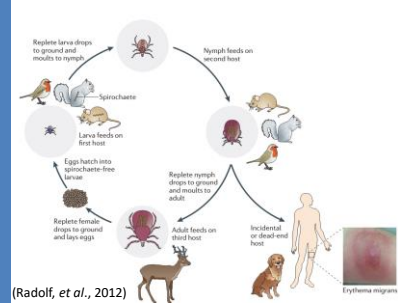


How to break out of the bacterial jail? Phage-encoded holin-endolysin system



The causative agent of Lyme disease is carried by ticks

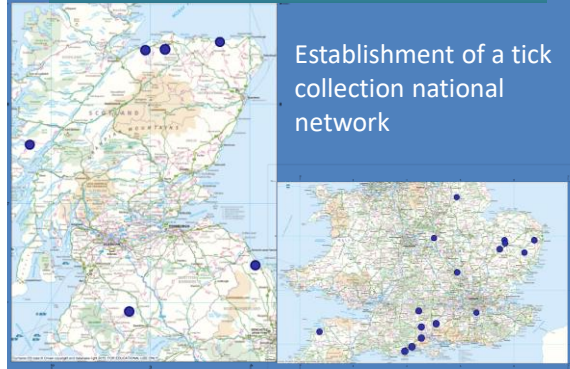
- Caused by the spirochaetes collectively referred to as *Borrelia burgdorferi sensu lato*
- The Lyme bacteria are spread to humans through the bite of infected ticks



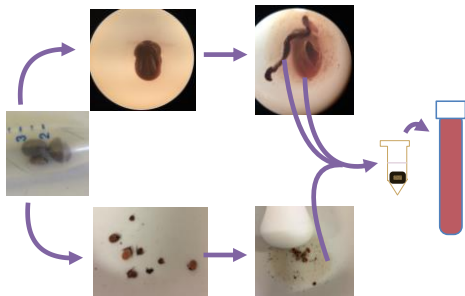
Borrelia strains have a unique genetic makeup

- A main chromosome (911 kb for the type strain B31), and 20+ smaller plasmids ranging from 5-50 kb
- Some of these plasmids are 'phages' or 'putative phages'. For examples, Cp32 plasmid family of *Borrelia burgdorferi* has been demonstrated to be phages
- Phages carried inside *Borrelia* strains can be induced out

Hunting phages from ticks

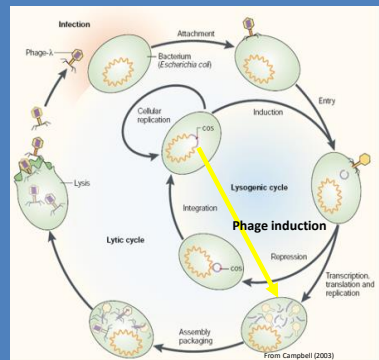


Tick dissection and enrichment

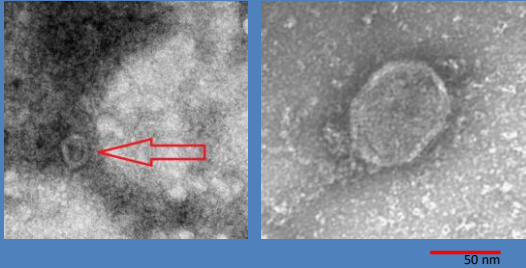


- Methods have been developed for to screen for biologically active phages (ongoing).

Hunting phages from *Borrelia*



- Temperate phages can be induced from *Borrelia*
- At least two different morphologies can be seen under transmission electron microscope (TEM).
- Phage purification (ongoing)



Development of a novel Lyme diagnostic method

- According to our survey conducted in the British shooting show 2016, the demand for a quick, highly sensitive Lyme disease diagnostic test is very high.



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**Thank you for
listening !**

