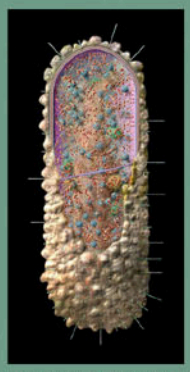
Ring-a-Ring-a-Rosy

DNA Analysis of the plague bacillus from Late Medieval London

Anthony McKeough



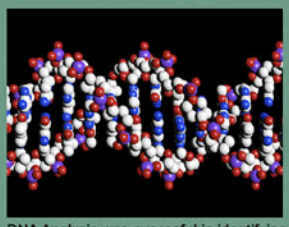
Cutaway view of *Yersinia pestis* bacteria, the causitive agent of the plague.

The plague has been one of the most devastating diseases throughout history. People have been exposed to the disease from as early as 1320 B.C, particularly between the mid 14th Century and the mid 20th Century. The widespread occurence of the plague left its mark on the archaeological record in the form of plague burials.

Despite the large number of plague burials, an accurate method of identifying the plague in archaeological remains does not exist. Conventional palaeopathology is only successful for diseases that leave physical manifestations on bone. The majority of diseases, including the plague, do not however leave visible signs on bone. This problem is exacerbated as historical descriptions of disease are often difficult to interpret.

This study aimed to solve the lack of methodology available to detect the plague by using DNA analysis to identify *Yersinia pestis* (the causative agent of the plague) in archaeological samples. Drancourt (1998, 2000) had prior success in detecting ancient plague using DNA analysis but this came from the use of dental pulp from unerupted teeth, which is not an abundant source of sample in archaeological remains. Six bone samples were obtained from the Royal Mint site, a London plague cemetary used from 1348, and were subjected to genetic testing in order to identify the DNA of *Yersinia pestis* in human bone.

Yersinia pestis DNA was detected in 1 out of 6 bone samples. Although only one sample exhibited traces of the plague, the technique still is valid in identifying plague in archaeological remains. Many other epidemics were present during plague outbreaks consequently causing what is termed "plague burial", to contain victims of other diseases. This problem helps explain why only one sample contained *Yersinia pestis*, and can also be solved as a resultof this research as the DNA Analysis method utilized can be applied to virtually all blood-borne diseases. The information gained from DNAevidence can be combined with historical documentation to provide a thorough, multi-disciplinary approach to the study of health in archaeological populations.



DNA Analysis was succesful in identifying the DNA of the *Yersinia pestis* bacteria in 1 out of 6 bone samples.

The flea (*Cheratophyllus fasciatus*) is the primary vector of the plague. The *Yersinia pestis* bacteria multiplies and blocks the oesophagus of the flea and is regurgitated into its host.

A method of plague identification from archaeological remains was needed which could utilize all types of bone samples. Previous DNA Analysis success was only obtained using dental pulp of unerrupted teeth, which is not an abundant source of sample.

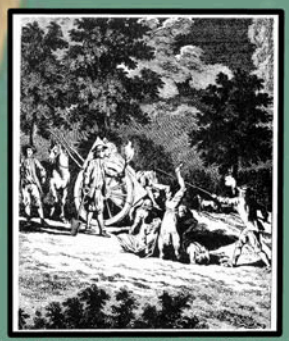
The black rat (*Rattus rattus*) was the primary carrier of the flea during epidemicoutbreaks. The black rat was alsoresponsible for the geographic spread of the plague as infected rodents would travel aboard ships and other convoys to unaffected areas and introduce the plague.

The horrific manifestations of the plague on the neck and hands of its victims. Despite these deformities no visible signs of plague are left on bone.

Many plague burials have been excavated throughout Europe such as the Royal Mint site, London (where the samples for this study came from) and the East Smithfield Cemetary depicted above.

Plague depictions show the grim conditions during plague outbreaks. The many dead can also be seen at the fiddlers feet.

London was struck severely by plague with the disease being attributed with killing two thirds of the cities population between 1348 and 1350.



The plague cartoon depicts one of the methods of disposing of plague victims bodies. The abundance of dead and dying victims collected were collected in carts and disposed of in mass burials.

References:

Drancourt, M. 1998 Detection of 400-year-old *Yersinia pestis* DNA in human dental pulp. PNAS 95:12637-12640.

Drancourt, M. 2000 Molecular identification by "suicide PCR" of *Yersinia pestis* as the agent of Medieval Black Death. PNAS 97:12800-12803.

Acknowledgments:

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The University Of Queensland

archaeological sciences laboratories