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# Black Death: Cultures in Crisis

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## Introduction

Between the years 1346 and 1353 CE, a terrible disease swept across Europe, the Middle East and North Africa, bringing death and desolation in its wake. This widespread epidemic, now known as the “Black Death”, caused dramatic losses, surpassing those of any large-scale disaster recorded before. In Europe, the disease killed an estimated 30–60% of the population over a five-year period (Benedictow 2004). Its impact elsewhere in the Old World is not as well known, but historical evidence suggest massive depopulation as well (Borsh 2014). By causing such a large demographic collapse, the Black Death initiated or enhanced major social, economic and political changes throughout Western Eurasia and Northern Africa (Horrox 1994; Borsh 2014). It also constituted the starting point of a period of high mortality, marked by recurrent outbreaks of the disease over the next four centuries (Biraben 1975). Due to its many effects on society and culture, the Black Death is generally considered as one of the most significant events of the late medieval world, and as a turning point in European history.

## Definition

The Black Death was the first and most devastating outbreak of the second plague pandemic, a major series of epidemics that took place between the mid-fourteenth and the late-eighteenth centuries CE. It is noteworthy that the term is a recent coinage that seemingly came into use not before the 18th century. In medieval sources, the epidemic was referred to using various and more general terms, including *epidemia*, pestilence, great death, and great mortality. It is commonly, but inaccurately, said that the term “Black Death” originated in the petechial hemorrhages (dark spots of blood under the skin) that sometimes accompanied the disease. The name more likely comes from a mistranslation of the Latin expression *atra mors*, where *atra* may mean either “black” or “terrible” (Benedictow 2004).

The second plague pandemic, as well as the Justinian plague (i.e. the first plague pandemic of the 6th-8th centuries CE), have long been considered to have been caused by the bacterium *Yersinia pestis*, i.e. the same etiological agent responsible for modern plague outbreaks. This gram-negative coccobacillus, which evolved from the closely related enterobacterium *Y. pseudotuberculosis*, is one of the most virulent pathogens known to humans. Humans, however, are only accidental hosts for the bacterium. Plague is primarily a disease of rodents (such as rats, marmots, and squirrels), which constitute permanent reservoirs for the bacterium. In modern-day epidemics, humans are most commonly infected by inoculation with the bacterium via the bites of fleas that had previously fed on infected animals (in particular, the rat flea *Xenopsylla cheopis*).

Plague can present in different clinical forms depending on the route of the infection. By far the most common is bubonic plague, in which *Y. pestis* bacteria spread to lymph nodes, where they multiply and give rise to enlarged purulent abscesses (the so-called “buboes”). Other symptoms of the disease include headaches, aching joints, nausea and vomiting. Without antibiotic treatment, about 40–70% of those affected with the disease die in about a week after appearance of the first symptoms due to cardiotoxins

released from the buboes. Although rare occurrences in modern outbreaks, the bacteria can also enter the blood stream or migrate to the lungs, leading to highly fatal forms of the disease (septicemic plague and pneumonic plague, respectively). Pneumonic plague is the only clinical form that has the ability to spread directly between humans, through inhalation of respiratory droplets from an infected individual.

A number of scholars have raised questions about whether or not the Black Death actually was an epidemic of plague, pointing to differences in mortality rate and epidemiology between the medieval epidemic and late-19th/early-20th plague outbreaks. In recent years, however, ancient DNA (aDNA) analysis of skeletal remains of plague victims provided conclusive evidence that *Y. pestis* was the causative agent of the second pandemic, including the Black Death (Haensch et al. 2010; Spyrou et al. 2019). aDNA studies also confirmed its involvement in the first plague pandemic (Feldman et al. 2016), and revealed that the bacteria already caused human infections as early as 5,000 years ago, while acquiring its ability for flea-borne transmission only during the Bronze Age (Spyrou et al. 2018). That *Y. pestis* was responsible for the Black Death is thus no longer a subject of controversy. Nevertheless, the reasons why the disease spread so fast and was so deadly in the medieval period are still to be elucidated.

## **Historical background**

### *Origin and spread*

The exact geographic origin of the Black Death, as well as the route the disease followed prior to its entry into Europe, remains uncertain. Most historians agree that the epidemic began somewhere in Asia, and travelled westward during the early fourteenth century, either via Silk Road merchants or via the Mongol army. An East Asia origin has been proposed based on genetic data, as modern *Y. pestis* strains that are directly ancestral to the lineage diversification that gave rise to the strains involved in the second plague pandemic have been identified in China near historical trade routes (Cui et al. 2013).

The first clear records of the Black Death place the disease in the Lower Volga and Black Sea regions in the mid-1340s. According to chronicler accounts, plague had been transferred to Europe from the Black Sea port of Caffa (modern Feodosia, Crimea), at that time a Genoese trading station. In 1345-1346, the Italian colony was besieged by troops of the Golden Horde (the Mongols who ruled over the steppes of southern Russia) who, after plague erupted in their ranks, allegedly infected the inhabitants by catapulting the bodies of victims over the city walls (Horrox 1994). Whether or not this story is accurate, the disease spread in the city, and the Genoese were forced to flee. Some ships managed to leave Caffa in the fall of 1347, passing through Constantinople (modern Istanbul) and stopping in Messina (Sicily) before returning to Genoa. By the end of the year, the disease raged in Constantinople, Greece and most of the Mediterranean islands (Crete, Sicily, Sardinia), and reached Marseilles in France and Alexandria in Egypt. The epidemic then disseminated rapidly both northward across Western Europe and westward across North Africa. Within a year, plague spread across France, Italy and Spain. By the end of 1349, it had colonized most of the British Isles and Germany. Continuing northeastward, plague infected Eastern Europe and the Low Countries in the next year, and reached the city of Moscow in 1352. In less than five years, the disease had spread everywhere, from Spain to the Urals and from Greece to Norway, sparing only a few regions.

After the Black Death, plague continued to rage in Europe and Northern Africa, as evidenced by the hundreds of recorded outbreaks for which it seems to have been responsible between 1353 and the late-18th century (Biraben 1975). While some studies have suggested that these later plague epidemics were caused by climate-driven reintroductions of the bacterium from reservoirs in Asia, genetic evidence currently favors its persistence in Europe in local rodent reservoirs (Spyrou et al. 2019).

## *Consequences of the Black Death*

Although an accurate death toll is impossible to calculate in the absence of reliable demographic statistics, it is estimated that the Black Death killed one-third to over one-half of the European population. Faced with a disaster of such an unprecedented magnitude, many contemporaries of the epidemic considered that the disease was a punishment from God for the sinfulness of mankind (Horrox 1994). This belief led, at first, to increased demonstrations of popular piety in an attempt to appease God's wrath. Public processions and masses were organized in many communities across Europe, and the Church encouraged the faithful to various forms of penance, including devotion to saints, pilgrimage and monetary offerings. In some parts of Europe, the Flagellants gained a large popularity, the members of this extreme penitential movement travelling from town to town and making bodily penance by scourging themselves in public. The ineffectiveness of any of these actions to stop the spread of the disease rapidly gave rise to other opinions and conspiracy myths, notably allegations that the plague had been caused by human agency (Horrox 1994). Accusations were leveled against virtually anyone viewed as an outsider, including foreigners, travelers, the poor, and lepers. But more than any others, the Jews were the most frequent scapegoats. Accused of causing the epidemic by poisoning wells and rivers, many Jews were harassed and expelled from communities, and thousands were massacred, particularly in Spain, southern France, and the Rhine valley.

At a loss to explain the cause of the Black Death, many people tried to escape the disease by fleeing from infected areas, abandoning their homes, villages and cities. Others, who could not afford to flee, cloistered themselves away and avoided public venues for fear that the disease spread from person to person. The popular belief in contagion also led some people to refuse to care for the sick and to bury the dead, and these duties were often left in hands of the more charitable and the poor (Fig. 1). As a result of the excessive number of corpses accumulating, burial sometimes could no longer be carried out individually, and victims were buried anonymously in mass graves. In some cities, existing graveyards became saturated and mass burial grounds were established, as in London where two such cemeteries were opened at East and West Smithfield.

Beyond its immediate effects, the Black Death also had profound long-term consequences. The most obvious was a drastic population decline, which was long-lasting due to repeated outbreaks of plague in the following decades and centuries. Although not matching the mortality levels of the Black Death, these later epidemics resulted in demographic stagnation in Europe, and populations did not return to their pre-Black Death levels until the 16th century in France, Italy and Spain, and not until the 18th century in England (Pamuk 2007). The massive depopulation caused a shortage of labor that ultimately resulted in an improvement in the standards of living for the working classes. While before the Black Death peasants had little latitude to negotiate wages, labor obligations or rents, those who survived the epidemic were now able to bargain for more favorable terms of employment as the supply of land generally exceeded demand. Similarly, craftsmen and paid laborers were able to charge higher prices for their services and goods. It resulted in a dramatic increase of real wages for both peasants and urban workers, while prices for food and housing generally went down (Horrox 1994; Benedictow 2004). Governments quickly attempted to curtail these economic shifts by adopting laws to limit wages and the movement of workers. These laws were only partially successful, and they motivated social uprisings such as the 1381 Peasants' Revolt in England.

Overall, the Black Death resulted in a redistribution of wealth, a reduction in social inequalities and an improvement in housing and diet for people of all social strata. It likely contributed to the end of the feudal system and diversification of the European economic culture (Horrox 1994). By reducing population size, the epidemic indeed offered the opportunity to use some lands for other purpose than raising food crops, which led to a progressive shift from grain farming to animal husbandry. Similarly, some of the grain mills could be repurposed, and were used to saw wood, to full cloth or to operate

bellows. The high cost of labor also encouraged the development of labor-saving technologies and the rationalization of working procedures, with the aim of increasing productivity.

The Black Death and later plague outbreaks also had long-lasting cultural and psychological effects on the European population, which are particularly apparent in art and literature. The dreadful trauma of these epidemics instilled an atmosphere of gloom and doom in society, leading writers and painters to move away from optimistic themes and to turn to an obsession with the plague and death. The *Danse Macabre* (“Dance of Death”), in particular, became an increasingly common theme in art through the course of the fifteenth century, which emphasizes the fragility of life and unforeseeable nature of death.

### **Key Issues/Current Debates**

A long-standing topic of interest to historians, the Black Death has also gradually become the focus of active archaeological research in recent decades. Various approaches and methods from a wide range of sub-disciplines have been used to attempt to detect physical evidence of the epidemic in the archaeological record, with the ultimate objective to confirm or refute claims about the effects of plague inferred from documentary sources. Possible archaeological evidence of the mass mortality caused by the Black Death and its social outcomes include mass graves, the abandonment or reduction in size of settlements, aborted building projects, and a decrease in goods production. To establish causal relationships between the epidemic and such archaeological findings is challenging as any one of them could potentially result from causes other than plague. In addition, some of these features are difficult to identify, and none is as common as could be expected, suggesting a great diversity of human responses to the Black Death and necessitating the use of multiple lines of evidence to reach informed interpretations.

#### *Archaeological evidence of population decline and economic disruption*

Landscape archaeology was the first branch of archaeology to provide a significant contribution to the scholarly study of the Black Death, through studies on deserted medieval villages (Fig. 2), which boomed in the 1950s, notably in England. Before these investigations, many deserted villages were thought to have been abandoned due to the depopulation caused by the Black Death and their subsequent failure to recover. Archaeological excavation and chronological characterization of a number of such settlements dismissed this hypothesis, showing that most investigated villages were not abandoned until the 15th century or later, when fields used for crops were transformed into pastures (Beresford and Hurst 1971). These results led to changed perceptions of the impact of the Black Death on rural communities, and suggested that most of them were resilient when faced with the epidemic. This does not mean, however, that villages as well as cities were not severely affected by population losses. In recent years, the mass mortality associated with the Black Death was persuasively demonstrated through a program of intensive test-pitting carried out on over 50 settlements from eastern England (Lewis 2016). Using frequency and spatial distributions of pottery sherds as a proxy of human presence, this study revealed population decline at all sites and frequent contraction of the settlements in the 150-year period that followed the epidemic when compared with the 150-year period that preceded it. While variable from one site to another, the decline in the number of pottery sherds was on average 45% across the region, with severe reductions recorded in both small villages and towns, as well as in both nucleated and more dispersed settlements, thus suggesting widespread depopulation.

The economic consequences of the Black Death are difficult to evaluate based on archaeological features and artifacts alone. However, archaeological and earth sciences may provide indirect evidence of some of them. For example, analysis of ice core samples from an Alpine glacier revealed a dramatic

drop in atmospheric lead levels concomitant with the Black Death, suggesting a sudden cessation of metallurgical production during the epidemic (More et al. 2017). Palaeoecological reconstructions of vegetation in northwestern Europe from pollen diagrams show significant changes in land use during the late medieval period, some of which may have been initiated or hastened by the Black Death. While the identified decline in cereal production probably began in Britain and France before the epidemic, the increase in forest cover in the second half of the fourteenth century may be the direct consequence of abandonment of farmlands and grazing lands due to a shortage of farmers (Yeloff and Van Geel 2007). Similarly, a large-scale analysis of dendrochronologically-dated European wooden constructions and comparison with annual records of plague epidemics revealed a correlation between building activity and the number of plague outbreaks, with the greatest decrease in construction occurring in the years following the larger epidemics (Charpentier Ljungqvist et al. 2018).

### *Burial evidence of mass mortality*

It is a common assumption that, due to brutal decimation of communities caused by the mid-fourteenth plague outbreak, burial traditions were strongly disrupted, and many victims were buried in mass graves. Multiple burials, therefore, are generally considered as the most reliable physical evidence on which to infer the possible relationship of a burial ground with the Black Death. It is noteworthy, however, that not all victims of the epidemic were buried in mass graves and that a large, albeit unquantifiable proportion of them were interred in individual graves that are generally indistinguishable from those used under conditions of normal mortality. This means, in turn, that certain sites of interment for plague victims may contain mainly, if not uniquely, individual graves, making them much more difficult to identify in the archaeological record.

Multiple burials are easily detectable through archaeological excavation (Fig. 3), as far as appropriate excavation and recording methods are used, in particular careful observations of the spatial arrangement of the skeletal elements to distinguish them from collective graves (i.e. places where several bodies were deposited successively over time). It is challenging, however, to establish the relationship of a mass grave with the Black Death, as plague does not produce lesions on bones and thus cannot be diagnosed based on visual, macroscopic or radiological examination of skeletal remains. Both historic documents and dating information may be instructive, but they are rarely precise enough to link a specific burial site with a specific mass mortality event. Analysis of the age distribution of the skeletal assemblage may also be informative, as plague was shown to have a specific demographic signature, which can be recognized across space and time (Castex and Kacki 2016). A secure diagnosis of plague, however, can be achieved only through biomolecular analysis of the victim remains. Over the past two decades, both paleogenetic approaches (e.g. Haensch et al. 2010) and paleoimmunological techniques (e.g. Kacki et al. 2011) have successfully been applied for the retrospective diagnosis of the disease. In recent years, newly introduced paleogenomic methods have produced groundbreaking results, permitting not only the detection of plague-specific aDNA sequences, but also the reconstruction of the whole genome of ancient strains of *Y. pestis*, thus opening the possibility of tracking genetic changes in the bacterium over centuries. These studies have produced compelling evidence for low genetic diversity and absence of mutations that account for increased virulence in the *Y. pestis* strains associated with the Black Death (Spyrou et al. 2019).

So far, archaeological excavations and subsequent molecular analyses of skeletal remains have made it possible to identify some 50 European burial sites related, wholly or in part, to the second plague pandemic, most of them in England, France, Germany and Italy (Fig. 4). Among them, 16 can be confidently attributed to the Black Death, while the others are related to later plague outbreaks up to the 18th century. Burial patterns observed at these sites reveal a great diversity in the way the communities responded behaviorally to plague mortality, and progressive changes in funerary practices over the

course of the second pandemic (Kacki et al. 2019). They suggest that during the Black Death people generally attempted to adhere closely to traditional burial customs. With the exception of a few burial grounds created especially for plague victims, such as the East Smithfield cemetery in London, most of the victims were buried in graveyards that were previously in use before the epidemic. Contrary to frequent assumptions, the deceased, although sometimes put in mass graves, were treated with great care, most of them being placed in the graves in an extended supine position, oriented east to west, with their heads to the west as in most Christian burials. During later plague outbreaks, burial practices underwent noticeable changes. Most of the victims were then buried in dedicated cemeteries, and their skeletons show more heterogeneous orientations and more random positions (e.g. prone positions, head-to-foot arrangements). Archaeological evidence also reveals that from the 17th century onward, most bodies were covered in lime, while this practice was unusual in earlier centuries.

### *Bioarchaeological research on the Black Death*

Skeletal remains derived from plague pits, which constitute the only direct evidence of whom the victims were, have become the focus of increasing interest in bioarchaeology over the past 20 years. Their analysis may provide insight into the patterns of mortality associated with the disease (as inferred from the demographic composition of plague assemblages), and on the variations in individual risk of death with respect to various biological factors (e.g. pre-existing health status, dietary status). By this means, bioarchaeology contributes to revealing the epidemiological patterns of plague in past societies, and to evaluating how its impact differed depending on environmental, socio-economic and/or behavioral factors.

A large part of the bioarchaeological research on the Black Death has centered on the 1348/1349 East Smithfield cemetery in London. The multiple paleodemographic studies conducted on this site resulted in mixed results, some concluding that the epidemic affected all age groups equally (Gowland and Chamberlain 2005), while others highlighted similarities between this skeletal sample and attritional assemblages, which were interpreted as an evidence that the Black Death killed indiscriminately with respect to age (DeWitte 2010). The major limitation with these studies is that all relied on the examination of a single site, making their conclusions difficult to generalize to explain epidemiological patterns of plague. In recent years, comparative analysis of various European skeletal assemblages associated with the Black Death and later plague outbreaks have produced results in favor of the non-selective nature of the disease, by revealing a similar pattern of mortality across these various sites, which fits with the expected age composition of a living population (Castex and Kacki 2016; Kacki 2017). In neither of these studies, sex was shown to strongly affect the risk of death.

In addition, a few studies have used paleopathological data to evaluate whether those individuals in poor health were more likely to die during the Black Death. Specifically, DeWitte's pioneering analysis of the East Smithfield assemblage has shown that people who developed skeletal stress markers earlier in life were more likely to die during the Black Death than those without lesions, thus supporting the hypothesis that *Y. pestis* infection was selective with respect to pre-existing health (DeWitte and Wood 2008). This conclusion is challenged, however, by the results of the study of four other plague burial grounds, which failed to demonstrate any significant difference in the risk of dying from the disease between individuals with and without skeletal lesions (Kacki 2017). The reason why these two studies differ in their conclusions is still to be elucidated, but this might lie either in temporal and/or spatial variation in the patterns of selectivity of plague or in methodological differences resulting in biased interpretations. In any case, further investigation on other large plague assemblages and consideration of other proxies for health (e.g. skeletal growth patterns, dietary status) will be needed to more confidently assess the influence of pre-existing health on the risk of dying from plague.

## International Perspectives

Much of the archaeological research on the Black Death has thus far focused on the Western Europe. England, in particular, has been central to the work of many scholars, whether they are interested in the social consequences of the plague-driven depopulation or in the mortality patterns associated with the disease. Bioarchaeological research on plague victims from the British Isles, for a long time restricted to studies on the East Smithfield cemetery, has been expanded in recent years to other burial assemblages, giving rise to interdisciplinary programs such as the *After the Plague* project (<http://www.aftertheplague.com/>). There is also a long tradition of research on past epidemics in France, notably with respect to the study of plague pits and the skeletons they contain. Although much work was done on burial grounds linked with early modern plague outbreaks (e.g. the 1720 Great Plague of Marseille), recent discoveries and investigations provided more data on the Black Death, which is now at the center of various scientific projects, such as the French National Research Agency's MORTUI research program.

Until recently, little attention has been paid to the possible physical evidence of the Black Death in other parts of the Old World. Such evidence is, for now, virtually absent from the Asian archaeological record, and they are limited in Eastern Europe to the identification of *Y. pestis* aDNA in a few fourteenth-century skeletons from the Volga region of Russia (Spyrou et al. 2019). A few studies have lately tackled the question of plague outbreaks in Africa based on the examination of archaeological evidence suggestive of population decline. These studies revealed changes in settlement patterns in late-fourteenth century Sub-Saharan Africa, a result considered as strongly supporting the still-debated hypothesis that the Black Death reached this region of the continent (Chouin 2018). However, other evidence for the disease, such as that for increased mortality and/or molecular detection of the bacterium in skeletal remains, is still lacking. Acquiring such evidence will be far more challenging than it has been for Europe, considering both the scarcity of mass graves in the archaeological record of medieval Africa and the generally poor preservation of aDNA in warm, tropical areas.

## Future Directions

Over the past decades, archaeological research has contributed to improve perceptions of the demographic impact of the Black Death and its consequences on medieval societies. However, the research conducted so far is clearly biased towards Western Europe. To draw a broader picture of the epidemic and its after-effects will require future research that transcends European borders, and produces more data for Asia and Africa. In this regard, analysis of settlement patterns in various parts of these continents will be important to assess possible changes in population density during the fourteenth century. Definite inferences about the geographical spread of the disease, however, will require molecular detection of *Y. pestis* aDNA from skeletal remains exhumed from these regions. Careful archaeological excavations focused on identifying deviant burial practices, along with improved paleomicrobiological techniques, will undoubtedly increase the chances of gaining such evidence in the future.

A better assessment of the depopulation caused by the Black Death, both in Europe and beyond, could probably be achieved through the generalization of quantitative studies such as those conducted on pottery sherds in England (Lewis 2016). Be it by a test-pit approach or through the analysis of archaeological finds recovered from extensive excavations, comparison of the amount of material remains from the pre- and post-Black Death periods will likely permit a more subtle quantification of the diverse impact of the epidemic in various localities and regions. In addition to ceramic remains, this approach would benefit from including other types of archaeological material, such as small metal finds or faunal remains related to animal consumption.



In order to gain a more globalized understanding of the origins and impact of the Black Death, it would be desirable that future research include more environmental studies. Such studies can inform how climate may have affected the development of the epidemic, as well as the impact of population size reduction on the environment. Ice core analysis and dendroclimatology are both promising in this area.

The scientific study of skeletal remains of plague victims is probably the area with the most potential for future research. Bioarchaeological studies have already produced insightful results on the mortality patterns associated with plague epidemics, but the studies performed to date do not provide definitive conclusions about the epidemiology of the disease across the course of the second pandemic. In the absence of mutations accountable for higher virulence in ancient strains of *Y. pestis* (Spyrou et al. 2019), the factors that made the Black Death so deadly are still to be fully characterized, as are the reasons why the mortality rates decreased in later plague outbreaks. Future studies should address these questions, by expanding anthropological analysis to samples from different areas and time periods to track geographic and temporal differences in plague mortality patterns by age, sex, pre-existing health condition, and other biological factors. If differences are found, they will provide greater insight on how environmental and socio-economic background influenced the mortality associated with the disease. Archaeogenetic research on both the bacterial strains and human hosts will also be fundamental in reconstructing disease dynamics. Analysis of a growing number of ancient *Y. pestis* strains will permit a detailed reconstruction of phylogenetic history of the bacteria, and help to refine scenarios about the spread of the disease in the various regions of the Old World. On the other hand, comparison of the genomes of Black Death victims with those of post-Black Death individuals has the potential to reveal if host genetic factors played a role in the immune competence of medieval populations and in the overall mortality level during the Black Death.

In addition to improving understanding of the factors acting upon plague epidemiology, bioarchaeological research can provide evidence for the after-effects of the Black Death on living conditions, health and life expectancy in medieval populations. Temporal trends in health and survival may be revealed by comparison of pre- and post-Black Death skeletal samples from the same site or locality, but few anthropological studies have investigated this question so far. The results of these studies suggest that both survivorship and health improved in the London population in the aftermath of the epidemic (DeWitte 2018). Further investigations on other burial sites, from distinct geographical backgrounds, are now needed to assess if similar improvements in living standards also occurred in other cities and in the countryside, in England and elsewhere. Future research would be enhanced by including stable isotope analysis to provide direct measurements of changes in diet between the pre- and post-epidemic periods. Combined with molecular data on the gene pool of the survivors, this approach could ultimately reveal how the Black Death shaped the biological characteristics of late medieval European populations.

## **Cross References**

- ▶ Bioarchaeology: Definition
- ▶ DNA and Skeletal Analysis in Bioarchaeology and Human Osteology
- ▶ Extreme Environments in Archaeology: Disaster
- ▶ Human Remains: Historic Cemeteries
- ▶ Medieval Archaeology
- ▶ Palaeopathology: The Study of Ancient Disease in Archaeological Human and Nonhuman Remains

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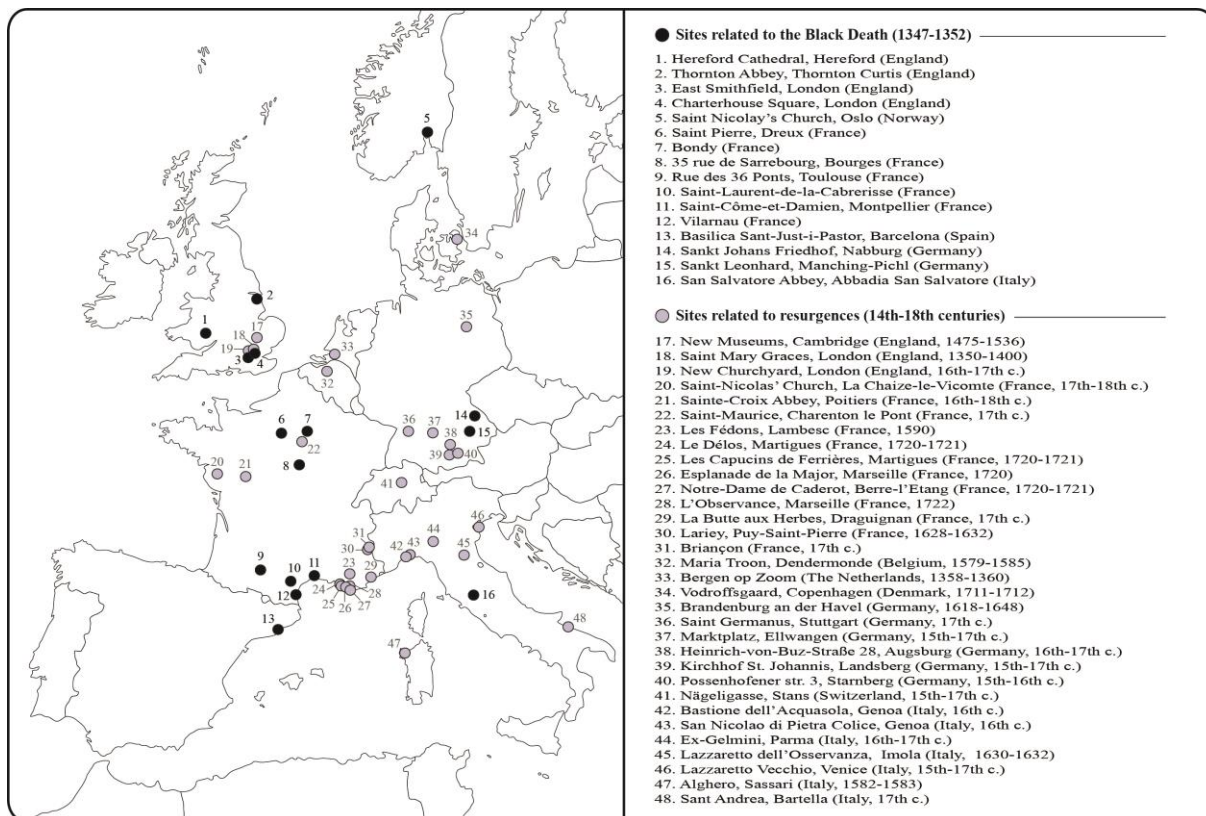
**Fig. 1** People burying victims of the Black Death in Tournai, Belgium. Miniature by Pierart dou Tielit illustrating the *Tractatus quartus* by Gilles Li Muisis (ms. 13076 - 13077 fol. 24v., Tournai, c. 1353).



**Fig. 2** Example of a deserted medieval village at Hound Tor in Devon, England (photo from Google Earth).



**Fig. 3** Multiple burials from Black Death sites at Toulouse (a) and Saint-Laurent-de-la-Cabrerisse (b) and from late-16th century plague cemeteries at Les Fédons (c) and Dendermonde (d). Images courtesy of M. Gourvenec (Archeodunum), A. Gaillard (Acter Archéologie), D. Castex (CNRS – PACEA) and E. Goudie Falckenbach (Antea Group), respectively.



**Fig. 4** Location map of European archaeological sites from which the graves of second pandemic (fourteenth to eighteenth century CE) plague victims have been excavated.