Epidemics and skeletal populations: problems and limitations

MARGARET COX

As a vehicle for the discussion of epidemics in relation to skeletal populations, this paper intends to concentrate upon the sample of 968 burials excavated from beneath Christ and All Saints Church, Spitalfields between 1984 and 1986. It is not suggested that this sample is typical, in fact generally speaking, very little is known about the historical background of most cemetery samples. The Christ Church material is exceptional in this respect.

BACKGROUND

The excavation of the crypt beneath Christ Church, was undertaken to retrieve a documented skeletal sample which would serve as a means of testing the reliability of the then currently employed osteological and forensic methodology. Surviving coffin plates gave the name and, consequently, the sex of 39.9 per cent (387) of the sample (the 'named sample'), their dates of death and ages at death (389). These data permitted further historical research. Sources such as church registers, wills, trade directories, vestry minutes, letters and diaries provided information about such topics as: abode at death, occupation, social class, marital history, the obstetric histories of the females, and for some individuals their apparent cause of death. Unfortunately, the Christ Church burial registers makes no distinction between crypt and churchyard burials and there is no known definitive list of intramural burials at Christ Church. Reconstructed life histories, and in some cases genealogies, make the named sample one of the most important skeletal collections in the world.¹

The crypt was in use from the Church's consecration in 1729 until 1859. The life spans of the named sample range from January 1646, the baptism of Susannah Hull, to December 1852, the death of William Louis Moinier Leschallas. This period encompasses what could be considered one of the most

dynamic periods of London's history. Susannah Hull lived through the Great Plague. Other notable epidemics and endemics of the period include smallpox, which declined as a cause of death in London after 1769, tuberculosis, syphilis and the early nineteenth-century epidemics of cholera and typhoid.

Approximately 40 per cent of the named sample were of Huguenot descent. The average life span of adults was fifty-six years for both sexes. Infants and children are under-represented in the crypt almost certainly reflecting burial practice. Only 53 infants were aged below two years (13.6 per cent), with a further 28 (7.2 per cent) aged between two and fifteen. The social and economic status of the named sample was such that most fell within Defoe's category of the middling sort, particularly in the eighteenth century. The most important economic activity amongst males was involvement in the silk industry in all its diversity.

SOURCE MATERIAL

The sources of data considered when assessing disease and mortality in this particular skeletal sample were both historical and osteological.

HISTORICAL DATA: GENERAL

A major historical problem in this area of research is our perception of the accuracy of diagnoses of cause of death as seen in documents from the seventeenth to the nineteenth centuries. Diagnoses that were meaningful, or at least descriptive, to contemporaries often have no diagnostic significance for us. To examine one disease, smallpox, a major difficulty is that the majority of infants died before the rash appeared and death was often attributed to such causes as "convulsions". Furthermore, the symptoms of fulminating smallpox were not recognized as such.3

Another area of concern is that the infectious disease itself may not have been the actual cause of death, but may have been responsible for that cause arising. For instance, some individuals survived the immediate effects of smallpox but succumbed to secondary infections such as bronchopneumonia and streptococcal septicaemia. What was the cause of death, pneumonia or smallpox? Furthermore, conditions such as latent tuberculosis can be triggered by smallpox. These examples go some way to demonstrating the complexity of the problem. When analysing surviving historical data relevant to cause of death, all of these aspects, and many others, must be considered.

3 Ibid.
### Table 1

<table>
<thead>
<tr>
<th>Name</th>
<th>Date</th>
<th>Age</th>
<th>Cause of death</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mary Kilner</td>
<td>07/01/1849</td>
<td>57</td>
<td>Found dead in bedroom without marks of violence</td>
</tr>
<tr>
<td>Jane Wilkinson</td>
<td>12/01/1842</td>
<td>79</td>
<td>Decay of nature</td>
</tr>
<tr>
<td>Frances Pulley</td>
<td>29/01/1843</td>
<td>82</td>
<td>Natural decay</td>
</tr>
<tr>
<td>John Megnin</td>
<td>10/02/1839</td>
<td>55</td>
<td>Chronic disease of the lungs</td>
</tr>
<tr>
<td>Hannah Brown</td>
<td>22/02/1843</td>
<td>75</td>
<td>Debility</td>
</tr>
<tr>
<td>Mary Trimmer</td>
<td>04/03/1842</td>
<td>45</td>
<td>Diseased heart</td>
</tr>
<tr>
<td>William Mills Pulley</td>
<td>16/04/1847</td>
<td>61</td>
<td>Disease of the spine, 5 years paraplegia certified</td>
</tr>
<tr>
<td>Sarah Hurlin</td>
<td>05/05/1830</td>
<td>73</td>
<td>Mortification in the feet</td>
</tr>
<tr>
<td>Anne Mecham</td>
<td>10/05/1839</td>
<td>54</td>
<td>Dropsy</td>
</tr>
<tr>
<td>Thomas Williams</td>
<td>03/06/1839</td>
<td>92</td>
<td>Decay of nature</td>
</tr>
<tr>
<td>Thomas Jackson</td>
<td>13/07/1839</td>
<td>63</td>
<td>Dropsy</td>
</tr>
<tr>
<td>Amme Vaux</td>
<td>01/08/1845</td>
<td>86</td>
<td>Natural Decay</td>
</tr>
<tr>
<td>Thomas Mecham</td>
<td>09/08/1837</td>
<td>53</td>
<td>Dropsy</td>
</tr>
<tr>
<td>Ann Walker</td>
<td>25/09/1838</td>
<td>87</td>
<td>Old Age</td>
</tr>
<tr>
<td>Henry Ladbroke</td>
<td>07/10/1847</td>
<td>75</td>
<td>Epilepsia since youth, hydropericardium for 6 or 8 months</td>
</tr>
<tr>
<td>Thomas Snape</td>
<td>20/10/1845</td>
<td>53</td>
<td>Pneumonia 4 days certified</td>
</tr>
<tr>
<td>John Daycock</td>
<td>27/10/1852</td>
<td>74</td>
<td>Congestion of Liver 7 days with bronchitis. Cerebral effusion 24 hours certified</td>
</tr>
<tr>
<td>Ann Harmer Stephens</td>
<td>28/10/1839</td>
<td>2yrs 9mths</td>
<td>Scarlet fever</td>
</tr>
<tr>
<td>Jane Stephens</td>
<td>06/11/1844</td>
<td>22 days</td>
<td>Debility and convulsions</td>
</tr>
<tr>
<td>Martha Smith</td>
<td>18/11/1844</td>
<td>52</td>
<td>Paralytic seizures</td>
</tr>
<tr>
<td>John Kilner</td>
<td>04/12/1847</td>
<td>70</td>
<td>Found dead in bed without marks of violence</td>
</tr>
<tr>
<td>John Desormeaux</td>
<td>08/12/1839</td>
<td>63</td>
<td>Asthma</td>
</tr>
<tr>
<td>Anne Mercer</td>
<td>09/12/1848</td>
<td>77</td>
<td>General decay</td>
</tr>
<tr>
<td>Sarah Pardieu</td>
<td>10/12/1839</td>
<td>86</td>
<td>Decay of nature</td>
</tr>
<tr>
<td>William Leschallas</td>
<td>13/12/1852</td>
<td>57</td>
<td>Shooting himself in the head with a pistol bullet; died in a few minutes. Temporary insanity</td>
</tr>
<tr>
<td>Thomas Stephens</td>
<td>13/12/1837</td>
<td>1yr 8mths</td>
<td>Inflammation of the lungs</td>
</tr>
</tbody>
</table>

**HISTORICAL DATA: SPECIFIC**

These fall into two main categories, those specific to individuals and temporal and spatial generalizations relevant to period and place. Specific data can be that noted on death certificates. Of the named sample twenty-eight individuals died after the introduction of civil registration on 1 July 1837. The death certificates of
two individuals (7.1 per cent) could not be traced. Death certificates only occasionally describe symptoms in enough detail to indicate, by our criteria, reliable medical diagnoses. Table 1 lists the causes of death known from death certificates. These are listed monthly to give a suggestion of seasonal factors. Only one entry obviously relates to an infectious disease, scarlet fever.

There are also descriptions of individuals' deaths in surviving letters. Some of these permit a 'best guess' at cause of death, others do not. An example of the former refers to the death of George Walker in May 1837:

He was taken on the Monday night previous with a bleeding at the nose which could not be stopped, and he gradually sank from loss of blood as several other vessels in his body broke, he suffered no pain he only complained of faintness.

This, with other evidence in the letter from George's son to his daughter, suggests that George suffered from thrombocytopenia caused by a leukaemic process.

In short, with the exception of the two year old with scarlet fever, no historical data has been found specific to individuals to suggest that those buried in the crypt died as a result of infectious disease.

SPITALFIELDS: A CHANGING ENVIRONMENT

The developing urban environment merits consideration as one facilitating epidemics. Spitalfields changed dramatically during the period. The area described by Stow in 1598 as covered with 'many fair houses' had by 1746, become the middle class suburb evident on John Rocque's map. By 1807, the Christ Church Vestry Minutes record that the parish was 'inhabited entirely by poor persons'. Population density increased dramatically after 1801, reaching 17,949 by 1831 and the value of property fell. Atmospheric and groundwater pollution inevitably increased as the area became industrialized.

The period through which the sample lived saw the characteristic wide climatic variability and effects of the 'Little Ice Age'. Food supply was affected, often adversely, and the quality could also be impaired by adulteration. The

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5 I am grateful to Lorna and Dudley Shone of St Francis Bay, South Africa, for permission to quote from letters they kindly provided referring to their ancestor, George Walker.

6 My thanks to Dr Keith Manchester of the University of Bradford, for bravely diagnosing the cause of death of George Walker.


8 Comparative Census Account 1801-1831 (1831).
potential for a range of infectious and other disease in the area was great, particularly in the later period.

One skeletal indicator of the deteriorating urban environment may be the prevalence of cribra orbitalia in the sample. Cribra orbitalia is considered to represent childhood iron deficiency anaemia and to reflect an adaptive immune response to increased exposure to pathogens. If the latter hypothesis is correct, it is interesting that Brothwell noted that 15 per cent of a seventeenth-century sample from East London had cribra orbitalia. In the Christ Church sample the prevalence was 34 per cent.

DISEASE AND MORTALITY IN SPITALFIELDS

The totals of annual burials at Christ Church listed in the Bills of Mortality (1729 to 1859) range from 213 to 942. Simple statistics derived from such data are flawed in many ways, discussion of which is outside the remit of this paper. However, for the 111 years for which data are available the mean is 535 with a standard deviation of 152. For the named crypt sample, the annual mean is 3.

The number of deaths during the years 1733 to 1741 are notably high for the parish, ranging from 691 to 942. It is interesting to note that among the causes of death in the Bills for London in 1741 (the highest year for the parish at 942) the figure for 'Fever' is in excess of 7,000, which is exceptionally high. However, when high mortality years in the parish are examined in relation to known crypt deaths, there is no apparent correlation. In fact, there are no known crypt interments from 1741.

The most notable year for known crypt interments was 1825 when 14 of the named sample were interred. The known crypt mean for the decade was 8. There were 723 burials within the parish for the same year, a high figure for a decade with a mean burial rate of 432. It would appear that the increase in the number of burials in the crypt in 1825 relates to a similar increase in the parish, whilst the high parish mortality of 1741 is not reflected in known crypt burials. There appears to be little consistency in this respect.

Specific contemporary comment about epidemic disease in the Spitalfields area was sought but with little success. This lack of information is of little consequence however, as when the abodes at death of the named sample were analysed (see Table 2), it transpired that place of burial need bear little relation to abode at death. At the time of their deaths, only 38 per cent of the named

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12 Molleson and Cox, *Spitalfields*.
sample (387) were resident in the parish, with another 39 per cent living in neighbouring parishes. A further 22 per cent lived in other London parishes with 1 per cent outside of London (one female died in France). Consequently, the epidemiological history of a parish need bear little resemblance to the epidemiological history of a skeletal sample interred there.

**Table 2**

Abode at death of those buried at Christ Church

<table>
<thead>
<tr>
<th>Abode</th>
<th>1730/1</th>
<th>1819/20</th>
<th>Named Sample</th>
</tr>
</thead>
<tbody>
<tr>
<td>Spitalfields</td>
<td>94.7%</td>
<td>75.2%</td>
<td>38.5%</td>
</tr>
<tr>
<td>Nearby parishes</td>
<td>2.6%</td>
<td>18.2%</td>
<td>38.7%</td>
</tr>
<tr>
<td>Other London parishes</td>
<td>2.5%</td>
<td>6.4%</td>
<td>21.7%</td>
</tr>
<tr>
<td>Outside London</td>
<td>0.2%</td>
<td>0.2%</td>
<td>1.3%</td>
</tr>
<tr>
<td>Sample size</td>
<td>931</td>
<td>645</td>
<td>387</td>
</tr>
</tbody>
</table>

OSTEOLeGICAL EVIDENCE

Many factors affect the survival and subsequent condition of bone. These include decomposition by bacteria, moulds and invertebrates; chemical action such as soil, water and acids; disturbance; recovery and post-excavation processes. Furthermore, many different factors cause skeletal variation and response. These include: genetics; environment including climate; nutrition; age at death; occupation; disease and its outcome - recovery or death; decay and fossilization.

Many diseases, particularly acute diseases such as smallpox, plague or cholera, do not produce pathognomonic or other changes in bone and so cannot be detected in skeletal samples. This is particularly the case where resolution of infection, or death occurs rapidly, long before the infection spreads to the bone. Bone lesions are usually manifestations of a response to chronic long-lasting infections. These are usually bacterial rather than viral and include tuberculosis, leprosy and treponemal diseases such as syphilis.

**TUBERCULOSIS**

Tuberculosis is a disease of considerable antiquity. It was considered to have been responsible for the deaths of about 20 per cent of the population of London.

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in non-plague years during the seventeenth century.\textsuperscript{14} There is a complex relationship between tuberculosis and leprosy. Both belong to the genus Mycobacteria and as leprosy declined, tuberculosis became more prevalent. There are no cases of leprosy at Spitalfields, but there are two of tuberculosis. Both are single focus lesions in children.

Despite the fact that according to the Bills of Mortality consumption (pulmonary tuberculosis) was a major killer throughout this period, there appear to be no cases evident in the 968 burials at Christ Church. Does this suggest that the high status population buried in the crypt were less vulnerable to this condition than the poor, or that the methodological criteria considered to indicate this condition need refining? The answer remains to be determined, but the latter seems the most likely explanation.

**SYPHILIS**

Venereal syphilis is a treponemal disease represented in this country in skeletal material from the post-Columbian period (although recently some probable pre-Columbian cases have been found). Deaths from the French Pox are relatively few in number in the Bills of Mortality and, not surprisingly, there are only two cases of syphilis among the crypt sample (968). Both are adult males, one of whom almost certainly died as a result of the condition. There are no cases of congenital syphilis.

**POLIOMYELITIS**

Poliomyelitis is a viral infection of the central nervous system. It is suggested skeletally by unilateral growth arrest and wasting. There are no apparent cases of poliomyelitis from Christ Church.

Clearly, a major limitation in using skeletons to research epidemics is the fact that most viral infections leave no osteological trace, and that with some bacterial infections diagnostic criteria are uncertain.

**AGE AT DEATH AND EPIDEMICS**

Generally speaking, the demographic consequences of infectious disease reflect whether or not the epidemic is affecting a virgin population. In such an event both old and young may die indiscriminately although young adults can be particularly vulnerable. Alternatively, where a disease immunizes those that survive, the processes of epidemiological adjustment determine that subsequent outbreaks will usually only effect children\textsuperscript{15} or immigrants.


In assessing the likely impact of epidemics upon cemetery samples, it is important to understand the epidemiology of contemporary infectious disease: theoretically, certain mortality profiles might then suggest the impact of epidemics upon the sample. Such interpretation relies upon the application of reliable ageing techniques with respect to human skeletons.

In the past, such interpretation has been hampered by ageing methods which presumed low life expectancy for prehistoric and historic populations. Consequently, but not surprisingly, the resulting estimated mean age at death was low, usually between twenty-five and thirty-five years. Latterly, methods have been established which extend the possible age range for adults. Whilst this is not the place for a full discussion of ageing problems, most British osteologists are fairly confident that at a population level, ageing methods for infants through to young adults are reasonably accurate. However, ageing mature adults is generally considered to be more problematic, largely reflecting the enormous breadth of human variability. Consequently, on a demographic level, cemetery samples are of limited value to the study of epidemics in the past.

A SKELETAL SAMPLE - OF WHAT?

A major, and rarely considered, problem in osteological research is deciding the representativeness or otherwise of a skeletal sample in relation to its presumed source population. It is rarely considered that a cemetery sample may not have a discrete source population, and that it may merely reflect a disparate group of dead human beings, whose collectiveness in death has no meaningful bearing, for many research purposes, on their lives.

As a consequence of knowing the identity of 40 per cent of the crypt sample, it is known that they do not represent any part of an homogeneous group of people from either a discrete temporal or spatial zone. Some are related, but they did not necessarily share either abode or life-style. Others were not related and hailed from both diverse and similar backgrounds. Members of the named sample were not necessarily subject to similar risks in terms of infectious disease.

It is known that 68,000 people were buried at Christ Church (both crypt and churchyard) between 1729 and 1859. Only 968 were excavated from the crypt (1.42 per cent) and of these only 387 had legible name plates (0.57 per cent) and could be identified. Of this 0.57 per cent, only 38 per cent resided in the parish

16 See Brothwell, Digging up bones.
18 Molleson and Cox, Spitalfields.
at death. This does not mean that they necessarily lived there prior to death, equally some of those dying elsewhere may have lived in the area, but there is at present, little evidence to support this.

Examining random samples (1730/1 and 1819/20) from the parish burial register (crypt and churchyard burials) it is evident that at different times between 75 per cent and 95 per cent of those buried at Christ Church were inhabitants of the parish (see Table 2). The named sample is different from the combined churchyard and crypt sample, which was itself not wholly representative of those living in the parish.

CONCLUSIONS

There are at present serious limitations and problems in the study of epidemics from skeletal populations. These are:

1. Relating historical evidence to skeletal populations introduces all of the problems and limitations of historical sources to the equation.
2. Infectious diseases caused by viruses cannot usually be detected in bone. There are problems in the diagnoses of certain bacterial diseases in skeletal remains.
3. Demographic assessment of human skeletal remains is considered by the author to be of limited value in this respect.
4. Cemetery samples need not represent discrete spatial or temporal populations.

None of these problems are insurmountable. They represent challenges that can be addressed, or reconciled, given both the intellectual will and adequate resources.

Related publication:
Margaret Cox, *Life and Death in Spitalfields 1700 to 1850* (Council for British Archaeology, 1996)