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Author: Piers D Mitchell

Contact Details: Dr Piers Mitchell

Department of Archaeology and Anthropology

University of Cambridge

The Henry Wellcome Building

Fitzwilliam Street

Cambridge CB2 1QH

United Kingdom

pdm39@cam.ac.uk

Improving the Use of Historical Written Sources in Paleopathology

Abstract

The texts written by the people of past societies can provide key information that enhances our understanding of disease in the past. Written sources and art can describe cultural contexts that not only help us interpret lesions in excavated human remains, but also provide evidence for past disease events themselves. However, in recent decades many biohistorical articles have been published that claim to diagnose diseases present in past celebrities or well known individuals, often using less than scholarly methodology. This article aims to help researchers use historical written sources and artwork responsibly, thus improving our understanding of health and disease in the past. It explores a broad range of historical sources, from medical texts and histories to legal documents and tax records, and it highlights how the key to interpreting any past text is to understand who wrote it, when it was written, and why it was written. Case studies of plague epidemics, crucifixion, and the spinal deformity of King Richard III are then used to highlight how we might better integrate archaeological and historical evidence. When done well, integrating evidence from both archaeological and historical sources increases the probability of a complete and well-balanced understanding of disease in past societies.

Key Words: art; crucifixion; historical texts; plague; retrospective diagnosis; Richard III

Introduction

The use of written or pictorial descriptions of life in the past should be a key source of evidence for any archaeological study of populations from historic time periods. Trying to interpret the archaeology of a past society without also consulting their written records not only makes our research unnecessarily challenging, but also increases the likelihood that our interpretation will be incorrect. When paleopathologists try to understand diseases in a past society, any written records are exceedingly important (Metcalfe, 2007; Patterson, 1998). Written evidence can be used to make a diagnosis of disease directly (retrospective diagnosis), or to provide social context to understand archaeological evidence for disease in a range of material such as skeletons, mummies or latrines. In this article we will consider the range of historical texts wherein descriptions of disease may be recorded, and we also explore the strengths and weaknesses of these sources. The aim is to help those publishing in the field of palaeopathology to create a richer, more nuanced, and more robust narrative to support their interpretations of disease in past societies.

Ground Rules for Interpreting Disease in Historical Texts

Our ancestors had many reasons to write. These ranged from a desire to flatter their ruler in order to gain favour, to the need to record purchases and sales and so ensure accurate financial accounting. This spectrum in the function of a historic text means that we need to interpret the words with full knowledge of when they were written, why they were written, and who wrote them. Before we go on to consider the unique nature of some types of texts, it is helpful to think about those key concepts that must be applied to every historic text we might read.

We must make sure that where possible we obtain our evidence from reading the original version of a historical text, not a modern translation, and not relying on the quotes of other secondary sources. The person who made that modern translation may not have particular expertise in health and disease, and so the choice of words to describe diseases may not be as accurate as we would like. In consequence, palaeopathologists may need to work with a medical historian with appropriate linguistic expertise to ensure that all the relevant source texts are consulted and that the choice of words in the original language is appropriately translated and understood. These source texts should where possible be contemporary to the disease event of interest to optimise the likelihood that descriptions of events were accurately made by eyewitnesses. However, there are certain contexts where it is not quite so obvious which might be the best text to use to study a disease event. An eyewitness account might only be preserved as a quote or paraphrase in a later source, or that later source

might have the advantage of access to several eyewitness accounts that give them a fuller picture of the event. That more helpful later account could even be in a different language. In such circumstances then the expertise of a historian should be able to weigh up the strengths and weaknesses of each available source. Knowledge of older texts from that same society also helps to differentiate original descriptions that were true reflections of witnessed events, from mere copies of older descriptions that were potentially added for literary effect (Mitchell, 2011a).

If we chose to use historical texts for past disease identification, we should be careful about interpreting historical diagnostic labels, which I term the social diagnosis. We cannot be sure that our understanding of a diagnostic term was the same as it was for the person who wrote the text centuries ago (Arrizabalaga, 2002; Cunningham, 2002). Descriptions of symptoms and signs of ancient diseases are easier for modern researchers to interpret than relying on the diagnosis made by a past healer, relative or bystander, when we have no way of checking what the term really meant to the person writing that text (Mitchell, 2011a). When interpreting recorded symptoms and signs of past disease, working with someone qualified in medicine can help optimise the accuracy of our interpretation of those descriptions.

Finally, it is important that we are frank and honest about our level of confidence in interpretations of disease from historical texts (Karenberg and Moog, 2004; Karenberg, 2009; Kean, 2012; Muramoto, 2014). Some texts only mention a few symptoms and signs when describing past disease events, and

many identical symptoms and signs may be present in more than one disease. This means we should qualify our diagnostic interpretation with easy to understand terms such as ‘possible example of’, ‘ is compatible with’, ‘a probable example of’, or ‘very likely to represent’ disease x or condition y. It is also sensible to also state the other conditions that might be compatible with a particular disease description (differential diagnosis) and to consider the reasons why our preferred modern biological diagnosis has been chosen.

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Differences in the Available Written Sources

Historical medical texts may appear to be the logical starting point when we wish to understand disease in past societies. However, past medical texts were not necessarily a summary of medical beliefs of their time, as they are today. When we get to know these texts well, it becomes clear that the elements of who wrote them, when they wrote, and why they wrote are key to our interpretations. Historical medical texts were often written to be presented to someone in a position of power. The hope was that having impressed this person, the medical author might be awarded a lucrative post at court or their careers might be advanced in other ways (McVaugh, 2006, 17). In consequence, the content, topic, or slant of the work may be affected by the nature of the prospective patron. If he were a warlord, then a larger section might be devoted to weapon injuries and venereal disease than if the patron was a religious leader,

who might not be impressed by illustrations of ulcerated genitals. If the author were an Italian writing in 1498 for a prospective French patron, it would be unwise for him to refer to the pox as the French disease (Arrizabalaga, 1997), whereas he might well do so for a prospective Italian patron. Furthermore, medical texts were generally written in a format that reflects the medical tradition of the time, often copying earlier medical texts to show the knowledge of that author. This means that a text may include diseases, operations, or other treatments no longer relevant to the time of its writing. We must be acutely aware of the tradition of medical authorship in a past society if we are to use the information found in their medical texts (Rosa, 2006).

Non-medical texts have an advantage in that they would not generally have been written with the scholarly expectations placed upon medical practitioner authors. They may well have been written with other non-medical expectations of course, in that the authors might have felt obliged to demonstrate scholarly knowledge of literary or historical works relevant to that culture (Partner, 1977; Robinson, 2003). Some non-medical authors may also have been taught the basics of medicine when they were young as part of what was regarded as a well-rounded education for their time. Similarly, medieval clergy often learnt some medicine in order to understand the human body, as they believed the body to have been directly created and designed by God (Cunningham, 1997, 38; Mitchell, 2016). This medical education of non-medical practitioners may potentially reflect the way they wrote. However, in most cases the expectations of how they should write would still be different to those writing

a formal medical text. When non-medical authors mentioned a disease in passing, they were less likely to be under any obligation to quote earlier medical authorities to demonstrate their knowledge of medical theory. Authors might write their personal observations of symptoms and signs in a clear and often vivid style. While they may not have known what special places on the body to look for signs, or have been in a position to examine a patient thoroughly, the more obvious affects of disease should still have been apparent. In consequence, there are many descriptions of epidemics and other noteworthy diseases in past non-medical texts.

Histories were attempts at recording a summary of historical events perceived as important by the author. Histories tended to cover a long time span, sometimes centuries before the author was born, ending during the life of the author. These historians generally used older written sources, oral tradition, and perhaps religious beliefs for the earlier sections but then incorporated eyewitness testimony for events during the author's life. Chronicles tended to focus upon a particular event with a defined beginning and end, such as a military expedition or reign of a monarch. They could be contemporary with events or written at a later date, and the author could have been an eyewitness or obtained their information from other eyewitnesses or compiled them from other written sources. Such eye-witness accounts of military expeditions or explorations have good potential to record diseases where they had a significant impact upon daily life, be they diseases indigenous to the location of the expedition, or those spread by the travellers to foreign populations (Mitchell, 2011b).

Epics and tales did not claim to be true and accurate accounts of real events, but were created to be exciting stories retold at social gatherings (Johns-Putra, 2006). They often started off as oral stories, being written down at a later time. In consequence, their date of original epic does not necessarily match the date they were written down. However, they tended to portray events in a way that was plausible and believable to those listening. In consequence, when they described diseases, injuries or treatment episodes they often reflected those conditions commonly seen at the time the epic was written. Despite the fact that such epics were not chronicles or histories, they may still give us information regarding the diseases present in the past.

Biographies summarise the notable events associated with famous people (Magoon, 1995; Reynolds, 2001). When they discuss the lives of medical practitioners, philanthropists or rulers, biographies may record diseases. Doctors may have described the disease for the first time in that society or cured people from it, philanthropists may have founded hospitals to treat people with that disease, and rulers or other notables may have died from it. In all these cases the information may be useful in our understanding of disease in the past.

Personal letters and diaries were written either with the intention of widespread dissemination or merely for the private use of one individual. A letter from a religious leader may have been intended to be read out at all the institutions allied to that religion, be they churches, mosques, or temples. In contrast, the thoughts of a soldier on expedition writing to his wife will be framed in a very different style due to the contrasting purpose of the letter. In order to

interpret letters, a good knowledge of the author, the recipient, the cultural context, the time period, and the reason for writing is all-important if an interpretation is to be accurate. If these criteria are met, the information in such letters can be highly illuminating. A diary may record the various stages of a scientific research project or the private thoughts of an individual with no idea that anyone else would ever read them. They might describe diseases the author experienced themselves or observed in their friends, or they could record examples of medical treatment in a way that more formal written documents may omit. When discovered after the author's death, diaries can provide unique insight into the experiences and suffering of a sick person.

Legal documents and wills tended to record circumstances wherein daily life interacted with a community's judicial framework in place. This may enlighten us regarding health and disease in a number of ways (Amundsen, 1971; Saris, 2007). Medical negligence legislation highlights the standards of treatment expected for certain diseases, and it may specify which diseases were felt to be incurable (Amundsen, 1974). Torture legislation may demonstrate when torture was used, what techniques were employed, and what punishments were handed down to those illicitly using torture (Mitchell 2006a). Homicide legislation may specify details relevant to forensic medicine and thus demonstrate past views on fatal and non-fatal wounds (Amundsen and Ferngren, 1979). Again, not all records concerning forensic medicine will be true accounts of actual events. A death may have been recorded as a suicide or homicide, but the legal record may either have reflected political or financial pressure exerted upon those

deciding the verdict, or it may have just been incorrect (Bailey and Mitchell, 2007). Legal documents may also explain which diseases were regarded sufficiently severe to use as an excuse if failing to appear in court to face charges or to give evidence, in contrast to less serious conditions (Mitchell, 2004b, 222).

Religious proclamations may be relevant to the history of disease if they record contemporary views as to why particular diseases occurred, were spread, or could be cured. Religious leaders may regard certain diseases to be consequences of the immoral actions of a sick person or their relatives. This was sometimes the case for leprosy in medieval Europe, although by no means everyone associated leprosy with sin at that time (Rawcliffe, 2006; Demaitre, 2007). Epidemics or other natural disasters might be interpreted as a consequence of god's displeasure with the human race in general, or the population of certain places. For example, in the ancient Middle East, Jewish tradition explained a catastrophic flood of the Euphrates River as sent by god to cover the whole earth as a punishment for immoral acts. This was adopted by the Christian tradition as the story was recounted in the bible (Genesis, ch6, v9). In the thirteenth century, the European military expedition to Egypt, known as the fifth crusade, was severely affected by dysentery. Archbishop Jacques of Vitry, the papal representative on the expedition, proclaimed that the outbreak in 1218 was god's punishment for soldiers' drunkenness, gambling, and consorting with prostitutes (Jacques de Vitry, 1960, 115-6).

Customs documents may record the import and export of materials used to treat disease, or the impact of disease on prices. Medicines and spices would

be taxed on entry to a region and if details of the material are noted, such information can be compared with medical texts of the period or the results of analysis of excavated pharmacy jars in the area (Moffat et al., 1989, fig 19). If diseases such as epidemics and malnutrition caused significant mortality, this may have had a noticeable effect upon the cost of goods (Saris, 2007). When farm labourers died and no one was available to sow seeds or bring in the harvest, food shortages may have resulted in higher prices. However, prices may have fallen if urban populations crash following an epidemic that spares rural areas, leaving food production at normal levels but fewer mouths to feed. Famine due to drought or crop failure might see an increase in imported foods from other regions, and we might also see prices go up.

Registers of births and deaths can provide huge volumes of data regarding life in the past (Wrigley et al., 1997). Different regions of the world started to collect such data at different times so the way they are handled will vary greatly with context. The stimulus for initiating collection and storage of this kind of information might include tax calculation and prediction, health monitoring, army service obligations, or the planning of government services. Accuracy from a modern perspective would, understandably, reflect the perceived importance of accuracy at the time the data were recorded. Again, this would be affected by the underlying reason for data collection and whether records were complete (Jonker, 2003; Jonker and Van der Vaart, 2007). If the general consensus at a certain time was that the exact age of death was not very important for such records, then entering an approximate age might be common

but never commented upon. If the social context was that death at an old age reflected well on a family's status, the recorded age might well be inflated to please the relatives. Such bias may be further compounded if the influence of population migration is considered (Ruggles, 1992). It may not be known when a migrant was actually born, so those completing death records may have estimated their age at death without us realising. Migrants also experienced the health environment of their previous location as well as the environment their new location. Depending upon this effect upon their childhood, they may be more healthy or more frail than those living at the location to which they migrated. In this way migrants may change our estimates of life expectancy at their place of death if we do not handle their data separately from those who were indigenous to the area. All of these factors could result in modern epidemiologists working with data with an unidentified error, leading to incorrect conclusions.

In another setting, the recorded cause of death may have been same term in the 1700s or 1900s, but the meaning of that word may be completely different in the two periods (Radtke, 2002). If a modern researcher uncritically compared the number of deaths from a particular disease in records from both periods, the prevalence might be seen to be have changed dramatically. For example, in Germany 'teething' was recorded as very common cause of death for infants in one Berlin parish from 1760 to 1810 (Imhof, 1987). It was rarely recorded before or after that period. No one dies from teeth erupting through their gums, so it seems likely these youngsters died from any of a number of diseases that tend to affect infants at the same time as their teeth erupt. Over time the fashion to lump

these illnesses together under the diagnosis of ‘teething’ disappeared. This demonstrates how the evolution in the meaning or use of the term might easily explain the changes in the numbers in these records, regardless of whether true prevalence of any of these diseases had changed over time. For this reason, investigating changes in data for years close together, perhaps to investigate famines or epidemics, will be more reliable than changes noted in records from different centuries.

Hospitals were only present in some past societies, but once this form of healthcare was developed then records can demonstrate the social status of people sought care in a hospital as opposed to care at home. They can also demonstrate the kind of diseases regarded as appropriate for care in a hospital as opposed to care at home. If treatment is recorded, then a reconstruction of events in such institutions can be created. All these variables would be expected to change over time and most likely be very different to modern views of what a hospital should be. At different times and geographical regions, hospitals may have existed for soldiers, slaves, the poor, people of particular religious beliefs, or people with specific diseases (Risse, 1999). Some hospitals did not even care for sick people at all, regarding their role as caring for frail, disabled, or elderly people who just needed more security and support than was available at home. Perhaps the classic example of this highly variable function is that of the *hospitale*, the Latin term for all these forms of hospital as used in medieval Europe 1100-1500CE (Carlin, 1989; Prescott, 1992, 1-2). This is in contrast to the Byzantine Empire (330-1453 CE), where different Greek terms were often

used to distinguish the specific role of such institutions. *Nosokomeia* and *xenones* were hospitals providing medical treatment to sick people, while *xenodocheia* helped the poor and hungry and *gerokomeia* helped the elderly and frail (Jones, 1983; Miller, 1997). If the language of the population concerned does not provide terms that specify the exact role of such institutions, automatically assuming the same function as hospitals take on today can lead to serious errors. Other supporting evidence for the function is generally needed in such cases before a detailed comment is possible. This might come from other written sources, or excavation of the institution and its cemeteries (Mitchell, 2006b).

Works of Art

Artwork such as paintings, sculptures, or engravings may depict disease in the past (Grmek and Gourevitch, 1998). The disease may be the focus of the work of art, or it may be incidental. The most common diseases investigated in this manner are skin diseases (Vérut, 1973; Ober, 1983; Dequeker et al., 1995), rheumatological conditions (Dequeker and Rico, 1992; Espinel, 1994), diseases causing disability (Anderson, 1994; Espinel, 1995), and epidemics (Kowalski and Agger, 2009). This may well be due to fact that they are often highly visible to the observer. A picture of a sick person may at first glance appear to be the perfect way to identify certain diseases, but the social context of the piece is paramount. In some civilizations the artistic tradition may result in a certain style that is not truly lifelike, but modify features to those perceived to be more beautiful or

desirable. This might include altering head shape or size, eye location on the face, the length of limbs relative to the trunk, or the size of muscles. A modern viewer without knowledge of this may interpret such changes as disease when in fact the person was completely healthy. Conversely, a wealthy person may have wished to have their portrait painted so that their disability or disease was less apparent than it really was. In consequence, the art may hide a disease described in written sources that really did affect that person. Artistic representations also varied in quality over time and with the talent of the artist (Baigrie, 1996; Jones 1998; Mackinney, 1965). Curved fingers may represent a disease such as leprosy, a nerve injury, or arthritis. However, they may merely reflect the style of the painter, or even a later modification of the painting. For example, the person may have originally been holding something in that hand that was later painted out, leaving the finger position to be over-interpreted by an enthusiastic modern observer. For all these reasons there has been much debate and difference of opinion regarding the interpretation of some paintings that may, or may not, have represented disease (Frenk and Faure-Fontena, 1995). Some well-known images of medieval disease can be found on the internet with explanatory captions stating the wrong disease. In order to avoid these mistakes, it is vital that manuscript illustrations are interpreted in the environment of the written text that surrounds them (Green et al., 2014).

Integrating Historical Evidence with Paleopathology

Plague of Justinian and the Black Death

The Plague of Justinian was an epidemic that spread across the Middle East and Europe in 542CE. The Black Death swept across Asia, Africa and Europe between 1348-52CE, and there were repeated later outbreaks every few decades. The symptoms of both pandemics do share many characteristics with modern bubonic plague, so it has been assumed by many that *Yersinia pestis* was responsible for the Plague of Justinian and the Black Death (Orent, 2004; Rosen, 2007; Sallares, 2007). Much more detailed records have survived for the second of these two pandemics, so the Black Death has been studied in greater detail. Interestingly, a number of studies have shown that the Black Death acted in a very different way to bubonic plague as we understand it today.

Disease mapping is a technique wherein data from written records are presented in a visual way to facilitate association recognition. For example, it can be used to plot disease spread in epidemics, to identify the source of diseases that cluster around a single point, to show the relationship between disease and geography, and to highlight the interaction between health and social factors, such as life expectancy from parish records and house address (Barrett, 2000; Barrett, 2003; Howe 1971; Rupke, 2000). Mapping of outbreaks has shown that the fourteenth century Black Death spread at 1-6km per day, a much faster pace than bubonic plague outbreaks in the last century (Christakos et al., 2005, 205-

6). Outbreaks in modern times are also much shorter lived than was the case for the Black Death, which continued for years. This is the case even for modern episodes where no effective modern treatment is available. Pneumonic plague, where disease is transmitted directly from one person to another by coughing, is extremely rare in modern outbreaks of *Y. pestis*. However, coughing and person-to-person contact appears to have been the major form of spread in the Black Death. Mortality in untreated modern bubonic plague (e.g. 1894-1950s India) was less than 10%, but the fourteenth century Black Death average mortality was up to 60% (Christakos et al., 2005, 231, 242-80). While mortality records are not as detailed for the sixth century Plague of Justinian, mortality must have been sufficiently high to cause the noted cessation of house building for the following decades (Kennedy, 2007). One Syriac author wrote of the Justinian plague that he was not sure he should bother writing his observations on the epidemic as there was almost no one left alive to read them (Morony, 2007). Finally, no rodent deaths were recorded in the Plague of Justinian or Black Death outbreaks, while dead rats in the streets were commonly associated with bubonic plague in recent times (Martin, 1996, 204-5; Cohn, 2008). This point has been supported by archaeological data showing that in medieval Scandinavia black rats were either rare or absent, yet plague still spread as rapidly as in the rest of Europe (Hufthammer and Walløe, 2013).

With this in mind, it seems clear that the Plague of Justinian and the Black Death did not affect people in the same way as the more recent outbreaks bubonic plague (Slack 1989; Theilmann and Cate, 2007; Cohn, 2008). But if the

consequences were not the same as modern bubonic plague, why was that the case? Some have written that the Black Death was not bubonic plague at all, and have identified other infectious diseases that they felt fit the records of the pandemic better. One team comprising a historian and microbiologist suggested the Black Death was actually a viral haemorrhagic fever (Scott and Duncan, 2004). This would have had a higher mortality than modern *Y. pestis*, person-to-person transmission, and have liquefied internal organs in the way noted in medieval autopsies of plague victims. Another theory was that Black Death was caused by anthrax (Twigg, 1984). Both of these theories would explain the absence of dead rats in the streets, and the diseases do share at least some of the symptoms recorded in eyewitness accounts. Despite these points, neither of these organisms have anywhere near a 60% fatality in modern outbreaks, as seen in the Black Death.

Possible explanations come from epidemiological and microbiological perspectives. It can be argued that exactly the same disease in modern times might have demonstrated a quite different epidemiological pattern in the past. For example, at the time of these epidemics in the Mediterranean world most cities had much smaller populations than they did by the time of the industrial revolution in the 1700s and 1800s. In the absence of large populations, the distinction between epidemic and endemic disease might be unlike that seen in modern times with cities with millions of inhabitants (Nutton, 2004, 19). A second hypothesis to consider is that *Y. pestis* just acted differently in the past since the epidemiological environment for it was different. From the microbiological

perspective, it has been argued that *Y. pestis* may have acted in a more aggressive manner at the time of the Plague of Justinian and the Black Death due to a genetic mutation that also negated the need for rats as a host (Walløe, 2008). This strain could have either died out or undergone further mutation before modern times. This would explain its higher mortality and faster spread in the past, in the absence of dead rats. The best way to investigate this theory would be with modern analysis of ancient pathogen DNA.

Over the last 5 years a number of studies have analysed the skeletal remains of people buried in mass graves dating from these two pandemics. Ancient DNA analysis of a 6th century mass grave from the time of the Plague of Justinian identified *Yersinia pestis* (Harbeck et al. 2013; Wagner et al, 2014). Similarly, aDNA analysis of medieval Black Death cemeteries in Europe has not only shown that *Yersinia pestis* was responsible for the Black Death, but also that different strains were circulating at the same time during this pandemic. The research goes on to demonstrate that the Justinian and Black Death strains were earlier on the phylogenetic tree than are modern bubonic plague strains (Haensch et al., 2010; Wagner et al., 2014). However, the genes that are thought to code for virulence and pathogenicity seem to have been the same as are found in modern strains (Bos et al., 2011). One possibility is that there are other unidentified genes that also affect pathogenicity and these were different in the ancient strains to the recent strains. Another possibility is that the pathogenicity of the plague bacteria has not changed, but that the human immune response has changed. If 30-60% of people died during these pandemics, then we might

expect the survivors to have had genes that gave some resistance to the infection. If this was the case, then natural selection in humans may explain why the disease appears more benign in modern outbreaks compared with ancient and medieval pandemics. This interpretation is supported by the finding that survival and mortality risk was better in those living in Britain after the Black Death than before the pandemic, even though there were repeated outbreaks of plague in the centuries after the Black Death (De Witte, 2014).

Crucifixion

This was a cause of death used in many time periods, but it is perhaps best known for its application in the Roman Empire. For religious reasons, the crucifixion of Jesus of Nazareth in 33CE has attracted the most interest from modern researchers, not least those interested in understanding how crucifixion actually caused death. At least ten distinct theories have been proposed as to the physiological reason that crucifixion victims such as Jesus of Nazareth died (Stroud, 1847; Lebec, 1925; Barbet, 1963; Davis, 1965; Wilkinson, 1972; Edwards, 1986; Lloyd-Davis and Lloyd Davis, 1991; Wijffels, 2000; Brenner, 2005; Zugibe, 2005; Bergeron, 2012). This wide-ranging opinion is at first glance quite startling. There are nowhere near ten theories for the microbiological etiology of the Black Death, Plague of Justinian, or other well known past disease episodes. However, on reading the detail of each of these papers, along with their methodology, it becomes understandable. High profile topics with media interest are always attractive to journal editors, as they may raise the profile of

that journal. The vast majority of articles on the subject have been written by medical practitioners who demonstrated no evidence for training in historical techniques or classical languages. While some at least found a modern language translation of the classical Greek or Latin passages describing crucifixion, many papers only referenced other similar articles. Little if any social context was provided by these articles, nor were the potential pitfalls in how the original sources might be used. The published palaeopathological evidence for crucifixion in Roman times (Zias and Sekeles, 1985) was either unknown to the authors, misunderstood, or misused.

Modern attempts to recreate human physiological experiments on volunteers with sham crucifixion has been claimed to be definitive (Zugibe, 2005, 108-122). Clearly none of the people in the study were actually whipped, beaten and then crucified with nails, and this is quite understandable. However, even within the constraints of ethical and reasonable science, the study design appears flawed for a number of reasons. The experiments were undertaken with volunteers in the head up position (Zugibe, 2005, 87), since this is the way crucifixion is depicted in churches. However, first century AD written texts describe how crucifixion was performed with the victim in a range of body positions from head up to head down, suspended by limbs or even by genitals (Josephus, 1528, 390; Seneca, 1840, 98-9). In consequence, modern tests employing volunteers in just one position cannot apply to any of the other positions used in Roman times. Secondly, the use of an incorrect foot position influenced by religious paintings and sculpture, rather than the archaeological

evidence, means the position of the crucifixion victim was not correct, even for those placed head up. The limited amount of archaeological evidence available suggests that the legs were placed on either side of the cross upright with nails inserted from lateral to medial through the heels (Zias and Sekeles, 1985). This would allow the legs to be held straight and thus support the weight of the body. The modern idea that both feet were nailed to the front of the cross with the knees bent seems to reflect artistic representations first created in the third and fourth centuries CE, not contemporary with the event they depicted (Maslen and Mitchell, 2006). Thirdly, Zugibe's experimental design was also strongly influenced by interpretation of the Turin Shroud (Zugibe, 2005). It has long been claimed by the Catholic Church that the shroud was the cloth in which the body of Jesus of Nazareth was wrapped after his crucifixion. However, radiocarbon dating of fibres from this shroud in three independent laboratories gave a result of 1260-1390AD (Damon et al., 1989). If these fibres do represent the original cloth, and not a later repair, this would clearly implicate the shroud as a medieval forgery. Fourthly, the experiments were terminated due to muscle cramps, not from any physiological deterioration in health. Zugibe interpreted the absence of breathing difficulties in the limited time each volunteer spent on the cross to indicate asphyxiation/respiratory failure could not have been the cause of death in crucifixion (Zugibe, 2005, 121). However, no volunteer developed any other significant physiologic disturbance to other bodily systems that would indicate an alternative cause of death. Clearly people did die during crucifixion, so Zugibe's

negative evidence for respiratory compromise or any other organ compromise merely demonstrates how his research protocol was suboptimal.

This example highlights a number of issues that are relevant to the textual study of disease in the past at a general level. It is important to bring the necessary skills in languages and interpreting texts, as well as medical knowledge, to explore complex topics such as disease in the past. Secondly, approaching a topic with a pre-existing expectation, be that religious or cultural, risks inappropriate influence on the research by those prejudices. Finally, while scientific study of historical problems has potential to be very helpful, it is only of use if a practical, impartial and methodologically accurate research protocol can be designed that is based on the full range of available historical and archaeological evidence. Otherwise there is a good chance that the apparent conclusions may be of questionable reliability.

King Richard III

The last Plantagenet king of England was Richard III, ruling from 1483-85. He died at the battle of Bosworth, with the victor Henry Tudor becoming Henry VII, founding the Tudor dynasty (Horrox, 1989; Baldwin, 2012). Richard III is well known for his villainous portrayal in a play written about him by William Shakespeare. He was described as an evil, deformed monster who had a hunchback, withered arm and limp and who killed his own nephews in order to ascend to the throne (Shakespeare, 1597). Since this account of Richard was written many centuries ago, it might seem reasonable to assume that it was an

accurate source of information. However, critical analysis of this source text raises a number of concerns.

John Rous was a contemporary of Richard III, and he described Richard's appearance as 'small of stature, with a short face and unequal shoulders, the right higher and the left lower' (Rous, 1486). There is no mention of Richard as having a hunchback, a withered arm, or walking with a crutch. So we must ask ourselves which description was correct, and why the description by Rous seems to be quite different to that of Shakespeare.

The skeletal remains of Richard III were recovered at the excavation of Greyfriars Friary in Leicester during 2012 (Buckley et al., 2013; King et al., 2014). Paleopathological analysis demonstrated that he did have a spinal deformity, a scoliosis. The degree of curve was about 70-90 degrees. Scoliosis of this severity results in one shoulder being a little higher than the other and one side of the chest more prominent on bending forwards, but it does not give the appearance of a hunchback. The skeletal analysis showed that there was no evidence for asymmetry of the bones of the arms that might indicate the withered arm described by Shakespeare. Similarly, the bones of the legs appeared completely normal and symmetric, with nothing to indicate he might have walked with a limp (Appleby et al., 2014). It seems that the description by John Rous was accurate, while that of William Shakespeare was quite inaccurate and exaggerated. It is important that we consider why this might be the case.

William Shakespeare wrote his play Richard III in the 1590s. This was about a century after the death of Richard III, so Shakespeare would never have

seen Richard himself and was clearly not an eyewitness. Shakespeare was writing when the ruler was Queen Elizabeth I, a member of the Tudor dynasty (Richards, 2012; Rowse, 2012). In order to gain royal favour, it would have been in his interest to flatter the queen and her ancestors. If Shakespeare could write a play that helped to legitimise the Tudor dynasty and thus show how they were more fit to rule than their predecessors, the Plantagenets, then we can see how the monarch at the time would approve. After all, Shakespeare was not writing a history as we would understand the genre today, but rather an entertaining story based loosely on historical events. This seems to explain why Shakespeare's depiction of Richard III was exaggerated and why it differs from the eyewitness description of John Rous.

Conclusion

It is clear that texts written by people who lived in the past can illuminate our understanding of past societies. They can give us information on the local culture to supplement the palaeopathological analysis of human remains, or such texts can act as a direct source of information on past diseases if clear descriptions of illnesses were recorded. A broad range of textual evidence has been described, and we have considered the different aspects of who wrote them, when they were written, and why they were written. These three elements are key to an informed use of written sources from past societies.

Using case studies, we have explored how evidence from written sources have been integrated with palaeopathological research in order that we may

understand certain topics at a more nuanced level. This has demonstrated how different modern researchers may sometimes use the same past descriptions to propose different retrospective diagnoses, and how past descriptions of the same illness may contrast with one another due to their distinctive social contexts. Such examples highlight how we must always strive to apply best practice to our interpretation of historical texts, focusing on eyewitness accounts, reading them in the original language and not modern translations, paying more attention to descriptions of symptoms and signs than to past diagnostic labels, and checking whether the wording is novel and original or whether copied from an earlier literature.

Our research teams need to include those with all the necessary skills for interpreting disease in past cultures, often needing contributions from paleopathologists, medical historians, and doctors. This interdisciplinary collaboration is sometimes difficult, as the questions asked by those working in the sciences are often different to those asked by researchers in the humanities, leading to a perceived gap or barrier between the fields that some feel should not, or even cannot, be crossed (Cunningham, 2002). However, by finding hypotheses of mutual interest to both fields, such collaborations can readily be established and be highly productive (Gould, 2003; Herring and Swedlund, 2003).

Finally, we must remember to think laterally in order to consider all the potential interpretations of past written descriptions of disease and to clearly state our level of confidence as to how sure we feel that interpretation is likely to

be correct. Using such an approach should hopefully avoid our becoming an entry in the encyclopaedia of pseudoscience (Williams, 2000). It should also avoid many of the confusing, competing claims for diagnoses of past disease events, and instead enable us to focus on using historical texts to help us understand the health of past societies in a positive and balanced manner.

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