Pia Bennike: PALAEPATHOLOGY
University of Copenhagen, Nørregade 10, P.O. Box 2177, DK-1017, Copenhagen K, Denmark

Abstract
Palaeopathology is the study of diseases of the past as seen on human remains. The interdisciplinary teaching programme aims to give the participant a survey of diseases related to time periods, geography and various cultures. The tutorials will be based on slides of human skeletal remains of the past and skeletal remains available for the course.

Examples of diseases which will be mentioned are: Infectious diseases (leprosy, syphilis, tuberculosis), nutritional diseases, growth anomalies, osteoporosis, traumatic lesions, fractures and treatment procedures, pathology in joints, bone tumours, congenital malformations and dental diseases.

Introduction
Palaeopathology is one of the most challenging branches of skeletal biology. It allows us to go beyond the purely morphological and descriptive aspects of what our ancestors looked like, to the study of their health and living conditions.

The techniques we apply to studies on palaeopathological material help to uncover numerous aspects of general health, diseases, aging, injuries and treatments. Paleopathology is therefore a multidisciplinary field where collaboration between persons with different academic backgrounds has proved to be most productive.

Many new technological methods have emerged in the last few decades and have been applied to a number of palaeopathological studies. They are valuable new tools for opening up branches of palaeopathology which have previously been more or less unapproachable and include: CT-scanning, SEM-microscopy, photonabsorptiometry for measuring bone mineral, biochemical and DNA analyses. Mathematical models have been applied to epidemiological aspects of palaeopathology with some success.

One of the most crucial and basic problems in palaeopathology is how to standardize methods, values and results. Without standardization, palaeopathology is confronted with serious problems regarding the reliability of conclusions, achieving new levels of knowledge and acquiring the attention that it deserves in the scientific arena.

Literature
One of the main problems in palaeopathology is that the literature is often rather sporadic and thinly spread in various international or local journals. This problem has partly been solved by the many new computerized internet facilities and partly by a very useful international bibliography of palaeopathological literature from 1997. The bibliography has been published in print but is also available on a disc grouped according to authors and subjects: Editor Rose Tyson; published by the Museum of Man in San Diego, California.

Two Cambridge Encyclopedias on worldwide views of diseases related to history, prehistory and geography have become important palaeopathological tools. One is the 500 page “Human Paleopathology” (1998) written by Arthur Aufderheide and Conrado Rodriguez-Martin. It is an important reference book for all those interested in the identification and meaning of pathological changes in human remains and describes each condition in context with history, antiquity, ethnology, epidemiology, geography, and natural history. The other encyclopedia, the “World History of Diseases” (1993) and edited by Kenneth Kiple. The 1100 pages include chapters on the History and Geography of Human Diseases and not least the chapter: Major Diseases Past and Present. The two volumes supplement each other in beautiful harmony.

Studies
In addition to the many new publications on palaeopathological themes, other areas of research have shown promising results. Among them are the microscopic studies of woven or porotic bone on the endocranial surface of the skull. This condition is most often found in very young children and may be related to fatal diseases such as meningitis and/or tuberculosis.

It has also been shown that various types of periosteal reactions on the bone surface are often caused by bleeding due to vitamin C-deficiency (scurvy), to edema, inflammation or infection (tuberculosis or lung infection when found on the ribs). Studies of similar changes in maxillary sinuses also seem to reflect pathological conditions. Systematic studies of a number of such minor skeletal changes were previously often ignored, probably because their meaning was not fully understood. They now play an important part in modern palaeopathological studies.

Small congenital and developmental defects of the skeleton which were described by Ethel Barnes in her systematic study from 1994 suffered the same fate. Now, the understanding of the embryological development of the skeleton and genetics suddenly appears to be of interest to many scientists who work on population studies.
An increasing number of skeletal studies focus on material from famine crises, poorhouses or slavery. However, the pathological findings do not always concur with the reported living conditions. The so-called osteological paradox may play an important role, in that rather few diseases are sometimes found in the weakest individuals in a society, namely those with a low resistance to disease and with a poor immune system often reveal only few traces of disease. They probably died before any disease could mark their bones.

Meetings
Conferences which focus on a single theme are relatively new with regard to palaepathology. They attract scientists from a broad spectrum of disciplines who are interested in a specific theme or disease. With the multi-disciplinary presentations, the perspectives of the theme increase dramatically and the many facets of a particular disease are brought to light.

One example was the very successful international conference on "Cranial Trepanation in Human History" held in Birmingham (2000). The purpose was to stimulate interest in and to get a view of the current knowledge of trepanation worldwide.

Infectious diseases. During the last decade, major infectious diseases have been discussed in a series of three very successful conferences. The first conference in Toulon (1993) was on treponematosis, the next in Hungary (1997) was on tuberculosis, and the last on leprosy was held in Bradford (1999). A conference on the plague took place in France in 2002. Even though the plague does not leave its mark on bones, the topic attracted a large group of people interested in history, palaeoepidemiology and palaeomolecular biology. On-going studies on DNA in relation to the plague are expected to provide us with new knowledge on the disease and the various types of plague.

The three conferences that have already been held on infectious diseases are documented in two voluminous publications on treponematosis and tuberculosis, which include the proceedings of the meetings, several plenum discussions and conclusive round table meetings. The two books are extremely valuable to those who participated as well as to those who could not be present. They simply provide us with a so-called "state of the art" with regard to the specific diseases. The third volume on leprosy is therefore expected with much anticipation.

The title of the first conference was: Syphilis before or after 1493? The spreading of the disease has puzzled the academic world from both a historical and epidemiological point of view for more than a century. Was the disease brought to the Old World by Columbus and his men? Or did it develop from non-venereal treponematosis which probably already existed on our continent?

Beside venereal syphilis, treponemal diseases include endemic syphilis (Bejel), Yaws (Framboesia, Pian) and Pinta which are not regarded as venereal diseases. There was a widespread belief among palaeopathologists that skeletal changes caused by venereal syphilis were so characteristic that they could easily be distinguished from the other types of treponemal diseases. However, several contributions at the meeting made it very clear that the pathological bone changes caused by the various treponemal diseases could not be distinguished from one another. This means that the previous mis-diagnoses of venereal and non-venereal treponematosis seem to have been at the root of the many opposing and sometimes misleading conclusions with regard to the spread of venereal syphilis.

It appears clear that our knowledge of this issue depends to a great extent on the reliability of: the diagnosis and 2) the dating of the bone specimens.

Skeletons from precolumbian times with evidence of treponematosis have been described in Australia and North America, whereas none have been found with certainty in South or Meso America. If both the dating and the diagnosis of the British skeletons prove to be reliable, they may play an interesting role in our understanding of how this disease spread. However, we still do not know which type of treponemal disease we are dealing with and molecular biologists are not yet able to distinguish the various treponemal diseases.

Tuberculosis and leprosy. Tuberculosis is caused by Mycobacterium tuberculosis and leprosy by another mycobacterium. In many European countries the decline of leprosy episodes in the 15th century seems to have been followed by an increase in the number of tuberculosis episodes.

Bovine tuberculosis may infect various animals, but the bacteria are mainly spread from infected cattle to humans via infected milk. It is, however, still an open question whether the bovine tuberculosis bacillus spread throughout the world population from a single focus of origin in the Near East, or whether there were multiple foci of origin in concordance with animal domestication.

Analysis of ancient DNA is a new tool in the search for more information about diseases. It may unravel molecular diseases, such as skeletal dysplasias. The isolation and identification of DNA from pathogenic microorganisms will open up new fields of palaeopathological interest. Molecular analysis may be feasible with respect to mycobacterial diseases, in particular TB. However, DNA of Mycobacterium tuberculosis has been found in a blind test in skeletons both with and without any evidence of the disease. Seven out of seven tested samples were TB positive which is rather thought-provoking.
useful in diagnosing the very few uncertain Neolithic cases, including one from Denmark.

Health index
A so-called “health index” has been developed and used to analyse the health status in various past populations in the Western hemisphere, mainly America. I will refer to parts of an abstract from an AAPA meeting by Steckel, Walker and Craig to explain what the “health index” means and includes:

“A series of research teams assemble the database using standardized recording techniques that allow direct comparisons to be made of conditions such as dental hypoplasia, porotic hyperostosis, non-specific infections, and traumatic injuries.

To obtain summary health indices, these observations were weighted based on the number of years the individual’s health would have been affected by a condition using model life tables.

The relationship between health status and local environmental conditions was explored using Geographic Information System databases containing site-specific information on topographic relief, precipitation, and seasonal variation in primary productivity.

Multiple regression analysis reveals that more than 40% of the variance in the summary health index can be accounted for by a model that includes site cultivation, cultigen use, and measures of seasonal variation in green-leaf biomass obtained from remote sensing satellites. The results suggest that Geographic Information System analysis of data from large-scale bio-archaeological surveys has great potential as a tool for elucidating the causes of variation in health of human populations”.

The idea of collaborating on uniform registration systems is brilliant and most welcome, but a database would not be particular valuable unless it was combined with the cultural history and local influences on the populations the skeletons derive from. If this is ignored or only included very superficially in order to accommodate world-wide computer programmes and mathematical models, the conclusions drawn from palaeopathological studies may become even more biased.