International Journal of Paleopathology 3 (2013) 145–149

Contents lists available at ScienceDirect

International Journal of Paleopathology

journal homepage: www.elsevier.com/locate/ijpp

Research Article

Paleoparasitology and paleopathology. Synergies for reconstructing the past of human infectious diseases and their pathocenosis

Olivier Dutour*

Laboratoire Paul Broca – Laboratoire d'Anthropologie biologique de l'Ecole Pratique des Hautes Etudes, UMR PACEA, CNRS - Université de Bordeaux, Avenue des Facultés, 33405 Talence Cedex, France

ARTICLE INFO

Article history:
Received 19 May 2013
Received in revised form
19 September 2013
Accepted 20 September 2013

Keywords:
Paleopathology
Paleoparasitology
Past human infections
Pathocenosis
Pathoecology

ABSTRACT

Paleopathology, a discipline studying human and animal diseases of the past, developed at the beginning of the 20th century. In 1910, the father of the discipline, Sir Marc Armand Ruffer, was the first paleopathologist to describe a human parasitic disease; urinary shistosomiasis on Egyptian mummies dating from the Dynastic period. Therefore, paleopathology and paleoparasitology have the same roots. However, since the beginning, these two fields did not evolve at the same scale, as the demography of paleopathologists, combined with that of anthropologists, increased much faster than the community of paleoparasitologists. On the other hand, since the last decade, a new field, paleomicrobiology, uses molecular techniques to identify ancient pathogen DNA. This approach has mainly been applied to bacterial pathogens, such as *Mycobacterium tuberculosis*, *Mycobacterium leprae*, *Yersinia pestis*, *Rickettsia prowazecki* and *Bartonella quintana*, due to the fact that anthropologists and paleopathologists are, for the moment, the main specialists dealing with molecular biologists. As the past human microbiological world should be considered as a whole, according to the concept of pathocenosis, it is time to establish a synergic link between paleoparasitology and paleopathology in order to significantly increase our knowledge of past human infections.

1. Introduction

The best definition of Paleopathology remains the first, formulated in 1913 by Sir Marc Armand Ruffer, who carried out pioneering work in this field. He introduced paleopathology as "the science of diseases which can be demonstrated on the basis of human and animal remains" (Ruffer, 1913:149). Ruffer started his career in paleopathology in Egypt, by conducting intensive research on Egyptian mummies from all periods.

To gain a better understanding of how Ruffer became interested in this field, it is worth recounting some aspects of his life (Sandison, 1967). Born in France in 1859 of a French father, the baron Alphonse-Jacques de Ruffer, Marc Armand became a British citizen, due to his secondary British education and medical studies accomplished at University College, London. Back in France, he was one of the first disciples of Louis Pasteur at the Pasteur Institute, at its very beginning. He then decided to specialize in the new rapidly developing science of microbiology. In 1891, he returned to London and was named the first director of the British Institute of Preventive Medicine, later to become the Lister Institute. Unfortunately, he was to become a victim of his research. While testing new antisera for diphtheria, he was so severely paralyzed by the toxin that he decided to resign his directorship. He then went to Egypt to recover his health. He settled in Ramleh and became Professor of Bacteriology at the Cairo School of Medicine. There he developed a growing interest in studying diseases on Egyptian mummies. The years 1910–1913 were decisive for the discipline, as Ruffer published the first paleopathological diagnosis of bilharziosis, by identifying *Schistosoma bilharzia* eggs in mummy kidneys (Ruffer, 1910) and his definition of paleopathology as a new science (Ruffer, 1913). Unfortunately, Ruffer did not live long enough to publish his body of work in paleopathology. In the spring of 1917, while returning to Egypt from Salonika, where he was in charge of the reorganization of the Greek sanitary service, he drowned at sea when his ship was torpedoed by a German submarine. After his death, his wife and his colleague Roy Moodie published in 1921 his major scientific contribution to paleopathology in a collected volume edited by Moodie and entitled "Studies in the Palaeopathology of Egypt" (Ruffer, 1921). The manner in which Ruffer could have developed his disciplinary concepts in paleopathology therefore remain unknown, but we can speculate that his first center of interest in microbiology and infectious diseases that he started at the Pasteur Institute would have influenced his body of work, particularly concerning the study of parasites on ancient Egyptian material.

* Tel.: ++33 540002552; fax: +33 540002545.
E-mail address: olivier.dutour@ephe.sorbonne.fr

1879-9817/$ – see front matter © 2013 Elsevier Inc. All rights reserved.
http://dx.doi.org/10.1016/j.ijpp.2013.09.008

2. Paleopathology and paleoparasitology as "sister" sciences

One can consider that paleopathology and paleoparasitology have the same roots, as they are known to have the same 'father', who is Marc Armand Ruffer.

Ruffer can indeed be considered as the real father of paleopathology. Shufeldt, who invented the neologism before Ruffer, did not display global multidisciplinary vision when he presented his neologism: "the word used in the title of this paper is a term here proposed under which may be described all diseased or pathological conditions found fossilized in the remains of extinct or fossil animals" (Shufeldt, 1893:679). Moreover, this short note, devoted to the description of some pathological conditions that Shufeldt observed on bones of ancient North American birds (for his main interest was ornithology), was his only contribution to paleopathology.

Some other authors proposed subsequent definitions, which minimized, consciously or not, Ruffer's original contribution to paleopathology. By presenting paleopathology as the "science of ancient diseases", these definitions emphasize chronological issues, therefore presenting a simplistic point of view. For instance, Møller-Christensen (1972), when proposing osteo-archeology as a new discipline, wrote: "Paleopathology has for many years been one of the fundamental disciplines of the history of medicine. The word 'paleopathology' means literally: the science of very ancient diseases. Due to the fact that we have no contemporary literary reports about diseases in prehistoric men and animals, we only can find information about this important subject by studying skeletons. Prehistoric skeletons can be difficult to date, and often their state of preservation is so bad that the diagnoses of the diseases are dubious, and sometimes it is pure guesswork. This is – in short – the contents of the research with the limited possibilities and uncertain scientific results which are characterized as paleopathology" (Møller-Christensen, 1972:411).

Therefore this author proposed the term "osteo-archaeology" instead of paleopathology, which he considered incorrect for naming the study of pathological conditions on skeletons postdating prehistoric periods. This neologism "osteo-archaeology" has (at least) four meanings all rolled into the same word, as it defines, according to Møller-Christensen (1972): (i) a specific method for excavating skeletons dating from historical periods, (ii) a way for constituting skeletal collections specifically adapted to pathological studies, (iii) results from these studies and (iv) an "auxiliary science" of the History of Medicine. As the 'osteo-archaeological' method of excavating, as described in this paper, can no longer be accepted by modern funerary archeologists and anthropologists, this obsolescence of the so-called "osteo-archaeological" method renders the other meanings of this term questionable. Caution should therefore be applied today when using this word as synonymous or equivalent to paleopathology (Dutour, 2011).

Restricting paleopathology chronologically to the study of ancient diseases is far from Ruffer's view, which defined paleopathology as an integrative discipline and did not introduce any chronological or methodological divisions or limitations. That is why the pioneering role played by Ruffer is indisputable, for it was he who actually set up research objectives in the field of paleopathology. This issue is, according to Ortner (2011), a critical basic question for paleopathology, as for any scientific discipline. Indeed, the objective assigned to paleopathology by Ruffer is to identify diseases on the basis on ancient remains, human or animal, whatever the methods used and the period concerned. This means that paleopathology adopts a holistic approach (even if Ruffer never used this word in his definition) and works within a multidisciplinary framework.

Therefore all scholars from biological/medical sciences or from social sciences and humanities with a scientific interest in past diseases can contribute to global paleopathological knowledge, whatever their specialty. This comprehensive view confirms the validity of Ruffer's definition, even with the recent development of new analytical methods, such as next generation sequencing and metagenomics.

As Ruffer was also the first to identify parasitic disease in ancient human remains, he is also appropriately considered a founder of paleoparasitology. Sandison validated this idea in his paper paying tribute to Ruffer's contribution to paleopathology: "Perhaps the most important was his discovery of the calcified eggs of *Schistosoma haematobium bilharzia* in the straight tubules of the kidneys of two twentieth dynasty Egyptian mummies [. . .]. This observation is of cardinal importance since it extends back the history of schistosomiasis for three millennia and substantiates the statements in the great medical papyri from ancient Egypt that haematuria was common. I suppose this might be regarded as the foundation of a new science of paleoparasitology [. . .]" (Sandison, 1967:152).

However, as Ruffer was not the author of this term and because his premature death did not leave him enough time to develop his concepts in terms of disciplinary issues, we cannot speculate on his willingness to make – or not – paleoparasitology a separate discipline alongside paleopathology or a subfield of it. The founder of the Paleopathology Association, Aidan Cockburn, pointed out the importance of studying intestinal parasites in human coprolites (Cockburn, 1967). Ferreira et al. (1979) named this approach paleoparasitology, and considered it as a new field of science (Ferreira et al., 1993; Gonçalves et al., 2003). Araújo et al. (1981), consider paleoparasitology a research field within paleopathology, studying parasitic remains from both archeological and paleontological contexts. Reinhard (1990, 1992) suggested that the word paleoparasitology should rather be applied to studies of nonhuman, paleontological parasitic remains, as 'paleo' refers to ancient paleontological times and proposed the name "archeoparasitology" or "archeological parasitology" for the study of parasitism among humans and domesticated animals, based on the analysis of remains of parasites from archeological contexts. In this view, archeoparasitology is a multidisciplinary field within paleopathology whereas paleoparasitology is a subfield of paleontology. This terminological distinction in the study of parasitism in the past is justified in terms of trends and distinct goals: paleoparasitology focuses on the evolution of parasite biogeography and archeoparasitology deals with the cultural ecology of parasitism in relationship to human activity. Concerned that this distinction could overly emphasize, mainly for scholars and students from other disciplines, the difference between the two, cohesive reviews have been recently presented (Dittmar et al., 2012).

If paleopathology and paleoparasitology (in its broadest sense) can be considered as "sister sciences", as they have the same paternity, they grew up differently. A swift bibliometric survey (Web of Sciences) using the two key-words revealed that the key-word 'paleopathology' is used by about 500 scholars; publishing their articles in various journals (20% of the papers are published in the *American Journal of Physical Anthropology*) and showed that 45 books (textbooks or research books) deal with this topic. Under the key-word "paleoparasitology" there are fewer than 50 scholars; publishing 50% of their research in one Journal (*Memorias Instituto Oswaldo Cruz*); and one textbook has been recently published in Brazil (Ferreira et al., 2011). This statistical discrepancy might be due to the fact that paleopathology was associated at an earlier stage with anthropology and recruited many scholars from this large scientific community; where paleopathology is taught as a branch of physical anthropology. The scientific community of paleoparasitologists appears to be smaller; mostly originating from archeological; environmental or biomedical sciences;