ANTHROPOLOGIE • XLIX/1 • pp. 79–88 • 2011

DOMINIQUE CASTEX, JAROSLAV BRŮŽEK, PASCAL SELLIER, PETR VELEMÍNSKÝ, HEDVIKA KUCHAŘOVÁ, MARYELLE BESSOU, STÉPHANIE SÈVE, JEAN-MARIE LOURENÇO, LIBOR JŮN, MILUŠE DOBISÍKOVÁ

BIOARCHAEOLOGICAL STUDY OF A MORTALITY CRISIS. CEMETERY OF ST. BENEDICT IN PRAGUE, CZECH REPUBLIC (17th–18th CENTURY AD): METHODOLOGICAL APPROACH

ABSTRACT: The analysis of past epidemic mortality crises is founded upon interdisciplinary problematics which closely associate archaeological, anthropological, and documentary sources. The multiple graves of St. Benedict's Cemetery in Prague (Czech Republic, 17th–18th century AD), evidence of an episode of surmortality, have been identified as resulting from a hypothetical plague epidemic on the basis of historical data, considered reliable by archaeologists. A thorough study of this exceptional, in number and state of conservation, osteological sample was carried out in order to obtain the most precise age estimates possible and thus identify any demographic anomalies, which could help establish the nature of the crisis that affected these individuals. The results produced new elements upon which to reflect. The mortality profile obtained from a substantial sample of individuals from the multiple graves revealed a very selective composition, where young male adults are very clearly over-represented; these observations, very different to those commonly seen in the context of a plague-type epidemic, led to a re-evaluation of the diagnosis initially proposed. After the use of original data (datings, handwritten sources, archaeological materials), a famine, possibly related to an epidemic, is now considered more likely. These new analyses certainly show that besides the demographic impact of a mortality crisis, human behaviour can introduce numerous supplementary biases to the demography of populations victim to an epidemic.

KEY WORDS: Europe – Modern age – Epidemic – Plague – Mortality profile

INTRODUCTION

Famine, war, and infectious disease are usually considered as events at the outset of very grave mortality crises (e.g. Cunha, Silva 1997, Kjellström 2004, Meyer 2003). Although regularly exploited historically, research into past epidemic mortality crises is relatively recent in the fields of archaeology and biological anthropology (e.g. Chamberlain 2006, Hills 2007). Twenty years of development in French preventive archaeology and a new way of considering the excavation of funerary complexes have favoured the discovery of several sites, resulting from crises of an epidemic nature, and led to the elaboration of an interdisciplinary research strategy (Castex 2008). In parallel, technical developments in molecular biology have shown great promise in the field of infectious pathologies, allowing the identification of certain germs in an epidemic context (Drancourt *et al.* 2004, Papagrigorakis *et al.* 2006,

Received 8 February 2012; accepted 13 April 2012

Raoult *et al.* 2006). When a crisis of an epidemic nature is suspected (presence of mass burials, lack of traumatic bone lesions), one point of fundamental research is to try and define its origin by exploiting the demographic characteristics of the osseous sample (e.g. Antoine 2008, Ubelaker 2007). Indeed, according to the nature of the crisis affecting a population – or a part of it – at a given time and place, the selection mechanisms of such populations will differ with regard to age and sex. Data from historical demography, as well as some archaeological sources, demonstrate that plague has a particular demographic signature, almost identical to that of a living population (Castex 2005, Hollingsworth, Hollingsworth 1971). However, there seems to be no general consensus about a typical plague "model"; for some authors the biases recorded between ordinary deaths and those linked to plague could certainly be linked in great part to the epidemic impact, but also inherent in the composition of the initial archaeological samples (Margerison, Knüsel 2002, Waldron 2001); others discover, as well as the fact of an epidemic, methodological problems linked to age estimation of a skeleton (Gowland, Chamberlain 2005) or even related to deficient sanitary conditions (DeWitte, Wood 2008). So, besides the epidemic factor, whatever its nature, human behaviour is capable of introducing numerous particularities into the mortality profile of an archaeological population: an already specialised composition in terms of age and sex, particular funerary practices, such as the exclusion of certain age groups (Blaizot, Castex 2005).

The aim of this paper is to prove that sites connected to mortality crises must be interpreted with caution; it is fundamental to question the quality of the available sources and to propose an analysis and critical explanation. Given its specificities (bone conservation, large number of individuals, well-established chronology), the St. Benedict site in Prague seemed likely to form an exceptional research structure for a better comprehension of past mortality crises, in terms of both funerary archaeology and palaeobiology.

ARCHAEOLOGICAL AND OSTEOLOGICAL SOURCES

The osteological matter comes from a rescue excavation undertaken in 1971 for the construction of the Kotva department store on the site of the ancient Church of St. Benedict in the Old Town district of Prague. The groundwork revealed a vast cemetery containing more than 800 graves dating from the late 11th to the 18th century. On the basis of various archaeological arguments, Czech archaeologists classed the tombs into five successive phases of inhumations related to the evolution of the buildings (Ječný, Olmerová 1988, Martinec 1971). Phases I to IV contain about half the tombs, a priori exclusively individual; they are dated from the early 11th century to the end of the first third of the 17th century, more precisely 1635, when the Order of Canons Regular of Prémontré (Premonstratensians, Norbertines) became the site's proprietors.

Phase V contains 462 individuals, buried in individual or multiple graves; it dates from 1635 to 1784, perhaps 1787, when the Premonstratensians cede the *Norbertinum* (college of the order). The chronology of the various plague epidemics affecting Central Europe generally is relatively well-known (Eckert 2000, Strouhal 2007), but certain documentary sources relative to Prague recount more precisely an episode of surmortality linked to the plague of 1679–1680 (Ječný, Olmerová 1988). The first complete osteological analysis of the individuals from the five phases of occupation of the cemetery was initially undertaken with the objective of obtaining detailed data on certain demographic (age, sex), pathologic, and metric aspects of the population of Prague from the Middle Ages up until recently (Hanáková, Stloukal 1988). During the fifth phase of occupation of the cemetery, no distinction had been made between those inhumed in individual graves, who classically would evoke "ordinary" deaths, and those inhumed in multiple graves, potential victims of the late 17th century plague related in the texts. We have therefore focussed on this final chronological phase and studied about half the multiple graves, that is, 15 tombs containing a total of 95 subjects.

ARCHAEO-ANTHROPOLOGICAL METHODS

Archaeothanatology

A certain number of points concerning the archaeological reality were clarified with the help of the ground plans and measurements, photographs and various documents of which we disposed and confirmation of the simultaneous character of the deposits inside the multiple graves was sought. This confirmation was initially sought by the analysis of field data, more exactly; the taphonomic observations which take into account the evolution of the articular relations between the bone parts inside the graves (Duday 2009). This diagnosis is fundamental in interpreting the site as it must show the distinction between "true" multiple graves, which correspond to the accumulation of several corpses in the same place over a very short period of time, and collective graves, where the deposits are spread out in time and therefore represent a more "ordinary" mortality. When the deposits are simultaneous, anatomic connections are generally respected because all the bodies decompose at the same time; inversely, when the inhumations are spaced out in time the installation of another cadaver can lead to disturbance in the arrangement of those skeletons already present (Duday 2007, 2009).

The graves at St. Benedict, Prague, are "true" multiple inhumations and show great diversity. Double and triple graves (*Figure 1a*) are most frequent; the deposits are regularly arranged, the bodies often superposed and laid head-to-toe or side-by-side. Some ditches contain a larger number of individuals: three contain the remains of more than nine subjects (*Figure 1b*), another contains as many

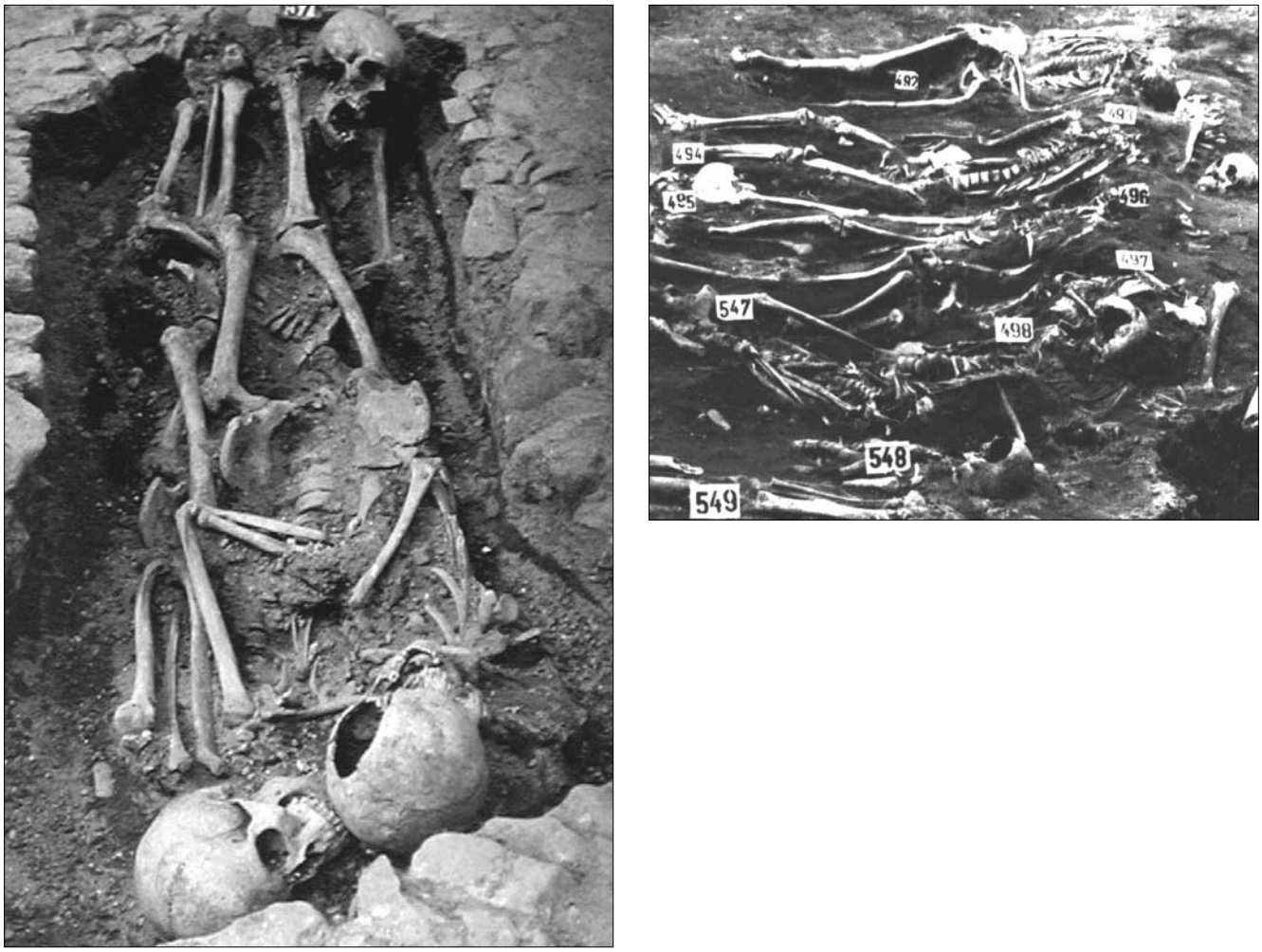

FIGURE 1. A triple grave (a) and a multiple grave (b) at the St. Benedict's cemetery, Prague (Czech Republic). Photo V. Martinec, Archive of the National Heritage Institute of Prague.

as 20 arranged in successive layers in deep, very narrow ditches.

Osteobiography

The search of possible stigmata due to inter-human violence (battle, massacre) was totally infructuous and the hypothesis of a classical epidemic mortality crisis was retained. Estimation of sex was carried out solely by using adult coxal bones using probabilistic sexual diagnosis or DSP (Bruzek *et al.* 2005, Murail *et al.* 2005). The age-at-death estimation of immature subjects was founded on the observation and quoted values of the stages of dental formation and resorption (Moorrees *et al.* 1963a, b). When teeth were absent, reference tables concerning the length of long bones (Scheuer, Black 2000) and ossification points of the skeleton (Birkner 1980) were used. The individual ages at death were divided into five-year groups (apart from the two youngest groups, respectively of one and four years) of age attained so as to allow comparison with Ledermann's (1969) life tables. For adult subjects the group under-30 years (20–29 years) was retained: this group can usually be well-identified as it corresponds to the phase of disappearance of the last traces of immaturity, such as the sternal point of the clavicule and the iliac crest (Owings-Webb, Suchey 1985).

We then tried to find evidence of possible differences between the results from St. Benedict's osteological sample and those expected from a supposedly "natural" population, with an age and sex distribution as "classic" as possible or as close as possible to that expected from a traditional population belonging to an archaic or pre-Jennerian mortality schema before the industrial revolution. To this end individual mortality profiles were established by calculating a mortality quotient (or probability of dying) for each age group and each quotient was compared to those of Ledermann's (1969) life tables. The references used concern a life expectancy at birth contained between 25 and 35 years (illustrated by a range of values in all presented graphs), this parameter being situated between 20 and 40 years in known pre-Jennerian populations (Sellier 1996). Our objective is simply to detect possible demographic particularities in the composition of the population by age and sex, anomalies which might provide information as to the origin of the multiple deaths.

RESULTS AND DISCUSSION

Mortality profile

A probability threshold of 0.95 was retained for male or female determination in the sex estimation. This estimation was carried out on all the adults and some older adolescents (i.e. about a quarter of them); the rate of masculinity appeared particularly high at 83.6%, compared with a theoretical rate of 50%. Indeed, male subjects are sometimes the sole representants of the multiple burials, in particular amongst those containing the greatest numbers of individuals.

Furthermore, the osteological sample under study revealed a very low proportion of immature subjects, only 27.4% of the total sample. Within a schema of archaic mortality, this ratio varies between 74 and 36% for a life expectancy at birth of between 20 and 40 years respectively (Ledermann 1969). On the contrary, the proportion of under-30 year-old adults represented is very noticeable with a ratio of 47.8%. Again within a schema of archaic mortality, this ratio varies from 18 to 10% for a life expectancy at birth of 20 to 40 years. Analysis according to age groups neatly demonstrates further anomalies (*Figure 2*). The most obvious is the clear under-representation of under-fives, with a total absence of the first age group. A clear disproportion between the age groups 5–9, 10–14, and 15–19 can be seen; there is a slow increase of the mortality quotients which peak in the 15–19 year and 20–29 year groups. This mortality profile is very different to that expected in the case of natural mortality and it would thus seem that there is a very selective composition, using age and sex criteria, of the population from the multiple graves (Castex *et al.* 2007). With regard to the initial historical hypotheses suggested, the connection to a plague epidemic must, of course, be debated.

"Plague"-type models in archaeology and historical demography

Three osteological series discovered in France currently allow a serious debate on mortality profile linked to a plague epidemic. The first site, Les Fédons, Lambesc (South East France) with 101 graves, is dated late 16th century (Bizot *et al.* 2005) with the existence of archival documents attesting its status as a plague infirmary cemetery. The second, Clos des Cordeliers, Sens, was excavated in 1989 and revealed 60 individuals inhumed in four adjacent graves dated 5th–6th century. Finally, the third, St. Peter's Cemetery, Dreux, excavated in 1990, revealed 72 individuals divided between nine multiple graves dated 12th–14th century. However, the data obtained, in both cases, provided different but complementary arguments for proposing the hypothesis of multiple burials related to epidemic mortality crises: simultaneity of deaths, contemporaneity of the different multiple graves, the absence of traumatic lesions which could indicate an act of war or a massacre (Castex 2008).

The examination of the mortality profiles of these three populations indicated a number of particularities (*Figure 2*). Although the proportion of non-adults to adults conforms to that expected in a theoretical population, several anomalies must be underlined. As a whole, at the three sites under consideration, the ratios between the immature age groups clearly indicate a non-natural population. Conversely, the variation in the sex distributions is much greater: the rate of masculinity at Lambesc and Sens is close to the theoretical rate of 50%, whereas at Dreux it is very high at about 70%. At Les Fédons, Lambesc, molecular palaeobiochemical analyses confirmed an episode of plague (Drancourt *et al.* 2005). The demographic anomalies detected in the mortality profile for the sites of Dreux and Sens was confirmed by the presence of the plague bacillus (Drancourt *et al.* 2004) and at Sens, the "Justinian" plague, this being the first evidence of the plague bacillus in the 6th century in Europe (Castex 2008).

At the same time, historical demographic data, although rare, show that, whatever the time and/or place, there is a certain concordance in plague mortality profiles, which is very close to those detected from our three archaeological series (Biraben 1975, Hollingsworth, Hollingsworth 1971, Mallet 1835) (*Figure 3*): a weak infantile mortality quotient

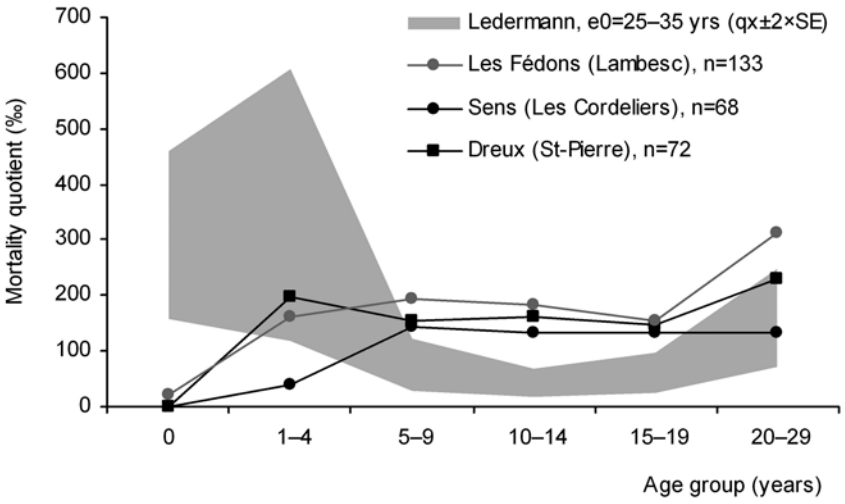

FIGURE 2. Age-at-death distributions at the sites St. Peter (Dreux), Le Clos des Cordeliers (Sens), and Les Fédons (Lambesc, Bouches-du-Rhône). Comparisons with Ledermann's (1969) theoretical values.

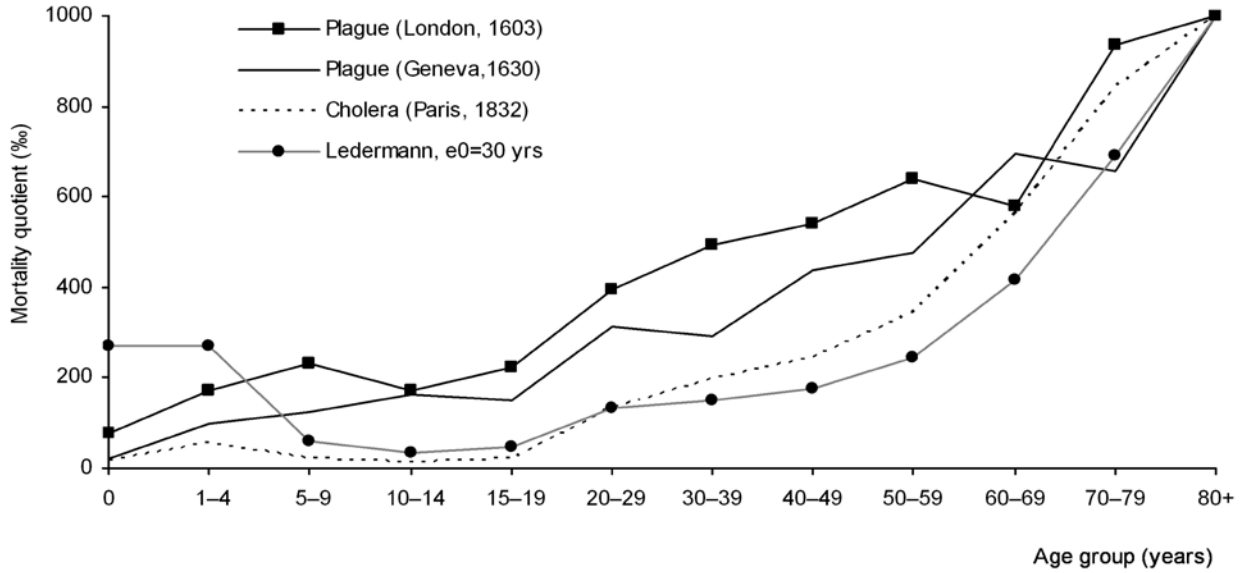

FIGURE 3. Comparison of mortality quotients for different epidemics (data from Biraben 1975, Hollingsworth, Hollingsworth 1971, Mallet 1835) with a natural mortality profile (Ledermann 1969).

and, inversely, a clear surmortality of young children, adolescents and adults can be observed during epidemics. When compared with the cholera, which occurred in the Czech lands in the first third of 19th century (Svoboda 2004), important differences in the demographic impact of the two scourges appear in particular among the oldest age groups (Mallet 1835). In fact the mortality profile of plague appears very close to the profile of a living population and thus shows evidence of the non-selectivity of *Yersinia pestis* with respect of the age of its victims (Castex 2005).

Prague's St. Benedict cemetery and plague in 17th century

Within the hypothesis that a plague epidemic caused the multiple deaths at St. Benedict's, the composition by age and sex of the sample from the simultaneous inhumations was compared with those of the confirmed plague sites. Apart from the differences observed with respect to natural deaths (*Figure 4*, *Table 1*), the mortality quotient curve at St. Benedict also differs from that expected in the case of plague, particularly in the relation between the quotients of the age groups 5–9, 10–14, and 15–19 and in the excessive numbers of the 20–29 year age group.

This divergence of profiles invites various comments. There may have been a plague epidemic, but it does not seem likely to be the only explanation for such anomalies in the distribution of age and sex at death. Besides the factor of the epidemic and its virulence, other mechanisms, which could have played a part in this abnormal distribution of

FIGURE 4. Age-at-death distribution at the St. Benedict site, Prague (Czech Republic, 17th century AD). Comparison with Ledermann's (1969) theoretical values.

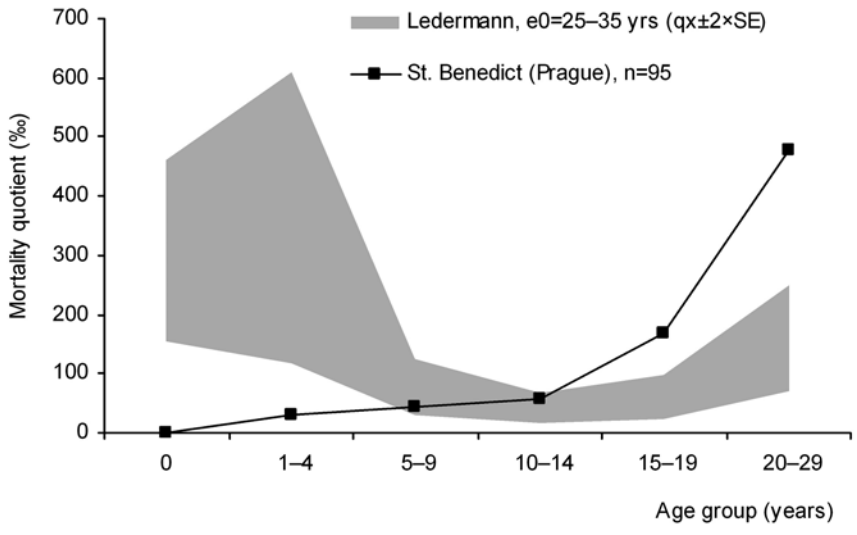

TABLE 1: Life table of the St. Benedict's site, Prague (Czech Republic, 17th century AD). Comparison with Ledermann's (1969) theoretical values.

Age group	S_x	D_x	q_x (‰) St. Benedict	q_x (‰) Ledermann e_0=25	q_x (‰) Ledermann e_0=35
0	95	0	0	460	156
1–4	95	3	32	608	117
5–9	92	4	43	124	30
10–14	88	5	57	68	18
15–19	83	14	169	97	25
20–29	69	33	478	247	70
30 and over	36	36	1000	1000	1000

S_x, number of individuals who entered into the relevant age category; D_x, number of deaths in the age group; q_x, mortality quotient; e_0, life expectancy at birth.

death, must be suggested. An explanation must be sought in the original composition of the group: this imposes a necessary return to archival data, alone able to identify the precise nature of the site and reveal a possible relation between the sector of multiple graves and the activity of the Order of Canons Regular of Prémontré. Perhaps the group had already been selected by criteria of age and sex with a great majority of young men? Could there be a social context compatible by age and sex with the composition of the sample? Could a different type of epidemic be responsible for such a composition? In this case a return to written sources is necessary to identify a precise event, maybe less significant than plague, but recorded by text. Evidently, molecular palaeobiochemistry analysis could be of particular interest in detecting a pathogen other than that of plague.

Historical contribution

Our research has been progressively refined thanks, notably, to consultation with the Premonstratensian Chronicles deposited at the Strahov library (*Annales seminarii S. Norberti Pragae, Tomus I and II*), written sources which cover almost the whole period of the college's existence from 1637 to 1785. We learn that the Premonstratensian canons settled at St. Benedict in 1635 and began to construct a new church and a college, the famous Norbertinum, from 1635 to 1639. This settlement is accompanied by an important easement: the cemetery of St. Benedict remains on their land but the sources are quite definite that the Premonstratensians have no business therewith. The Premonstratensians are never interred at St. Benedict but at the Strahov or at their Premonstratensian abbey of origin. However, a few lines in the yearbooks mention several episodes which could have provoked occasions of surmortality. In 1639 before the Premonstratensian buildings have barely started their activities, they are requisitionned as a lazaretto by the German Emperor's army. Certain troops, passing through Prague suffer from *dissenteria et peste* (in Latin). The term *Peste* in Latin in the text can mean any important disease, not necessarily plague. There are, of course, specific regulations which prohibit inhumations inside the town during episodes of plague, as evidenced by certain writings regarding plague in Prague in 1639 as in other Czech towns (Schultz 1901), but could there possibly have been inhumations at St. Benedict?

Besides the aforementioned event, three episodes of crisis are to be noted at St. Benedict and Prague in general: two episodes of plague in 1680 and from 1711 to 1714, and an episode of famine due to the siege of the town in 1742. During the latter episode the French troops and their allies (armies of Bavaria and Saxony) occupied Prague and were besieged by the Imperial troops of Marie-Theresa of Austria (an episode in the Austrian war of succession); the Norbertinum was requisitioned as a military hospital by the French troops. Assieged by the Austrian troops during summer 1742, Prague was conquered in December after months of famine. Other sources also relate this episode of the Austrian war of succession, accompanied by a memorable subsistance crisis (Theinhardt *et al.* 2005). The same references allow the exploration of several other episodes of crisis. One of the most important may be the 1599 plague but a relation with the multiple burials at the St. Benedict's cemetery seems unlikely considering the chronology proposed for the phase V graves. The great fire in 1689, which ravaged part of the right bank of the Old Town, could be considered although there is nothing to indicate an identifiable mortality crisis. The occupation of Prague by the French and Bavarian armies from 1741 to 1743 (Weber 1896) and sieges of Prague by the Prussians in 1744 and 1757 are also mentioned, but again, there is nothing to assert reliably that these bellicose episodes led to an important surmortality. Only the great famine which affected Prague in 1771, a year of poor harvests, presents a serious lead (Theinhardt *et al.* 2005). It seems unlikely that the burials at St. Benedict took place after 1787, at which date the Premonstratensians ceded the Norbertinum definitively to the army for its transformation into a barracks, or after 1792 when St. Benedict's Church was demolished.

Radiocarbon datings

In the face of such interrogations, reliable dating becomes of the utmost importance. Several radiocarbon datings on human bones were undertaken. The datings were undertaken at the *Laboratorium Friedrich-Alexander-Universität*, Erlangen-Nürnburg, and at the Research Laboratory for Archaeology and the History of Art, University of Oxford. The results have brought important additions to the chronologies first proposed by the Czech archaeologists.

A sample of three individuals from the same multiple grave (Subjects H60, H83, and H797) were dated respectively 1684–1927, 1660–1954, and 1683–1929 with a reliability of 95.4% and another individual from a different multiple grave (Subject H75) was dated 1667–1946, also with a reliability of 95.4%. Three other datings concerned subjects from individual graves (respectively subjects H36, H270 and H421): two were dated respectively 1449–1662 and 1475–1662 with a reliability of 95.4%, the other 1487–1662 with a reliability of 89.1%.

If we trust these first seven datings two groups of burials seem to emerge: the first concerning the individual graves situated as a whole before the second half of 17th century, the second regrouping the multiple graves all later than 1660. These data refute the initial classification of these individual graves into the last phase of burials in the cemetery, phase V dated 1635–1784 (Ječný, Olmerová 1988), but are, on the other hand, consistent, in part at least, with the texts of the Premonstratensian Chronicles which assert that there were very few burials in the cemetery after 1635 and elsewhere confirmed by the entries in the Prague State Archives Register, where no burials are mentioned at the St. Benedict's cemetery in 17th and 18th century. Nevertheless the multiple graves present at that period let us suppose that at the time of a mortality crisis, the St. Benedict's cemetery was active for a short and precise length of time.

Archaeological artefact

Recently, among the archaeological objects associated with the skeletons from the multiple graves, 17 brass/copper buttons have been identified from two multiple graves (Subjects H63, H75, H79, H82, and H506) as military in origin (Bleckwenn 1984, Karger 1998). These buttons could be dated 18th century but in the absence of specific ornaments or decorations, relatively frequent at that epoch, it is difficult to define the type of military uniform or the regiment to which they could belong. Some of the buttons found could be associated with military gaiters. The hypothesis of an artillery troop, soldiers in the army of the Habsburg monarchy remains pertinent.

At this stage of the study, we possess a number of elements permitting a reformulation of our hypotheses regarding the origin of the deaths which affected the subjects at St. Benedict. On the one hand, the new radiocarbon datings allow us to propose a new chronology in the succession of the different types of burial in phase V: the individual graves would be anterior, at least in part, to the multiple graves. There would therefore be two, clearly distinct, periods of inhumation, each implying a different handling of the deaths. On the other hand, the hypothesis of a group of Premonstratensian canons and a very selective composition of the population buried in the multiple graves (essentially young men) has been rendered inappropriate by archival research and, combined with the study of a part of the archaeological materials (buttons identified as belonging to military uniforms), we can now focus more precisely on an episode of crisis such as the siege of Prague in 1742, during which Bavarian or French soldiers may have died from the effects of famine, a fertile field for the development of different epidemics. Although plague no longer seems the most likely epidemic, a first tentative attempt at identification brought a negative result. However, the absence of pathogens does not exclude the possibility that they may have existed. Other endemic diseases such as typhus, dysentery or scarlet fever could be indicated.

Although an interpretation of some of the multiple graves discovered at St. Benedict's, Prague, begins to emerge, it seems, however, important to note that two other burials with simultaneous deposits and from a sector far from the precedent have recently been dated (Subjects H356 and H549, here we have again chosen two different dating laboratories). The chronology revealed is earlier, 1466–1635 for the first and 1472–1653 for the second, with a reliability of 94% in both cases. They are contemporaneous to the first individual graves dated (cf. supra). One is triple and could, perhaps, represent a collective accident but the second is more important (more than 17 subjects are concerned). They could correspond to an episode of surmortality prior to that studied up until today.

CONCLUSIONS

The site of St. Benedict at Prague provides an example where the archaeo-anthropological approach is no longer simply complementary to the historical approach; it has shown that an efficient organisation of the research could take into account different levels of reflection and thus allows a reinterpretation of the data.

The analysis of the parameters of age and sex has produced a mortality profile which, compared to a characteristic plague model, has led us to challenge the hypothesis, maybe too readily accepted, of such an epidemic and to propose new interpretations after further and necessary study of the initial datings and a greater exploitation of historical sources. If the model of plague initially proposed can now be refuted, in the great majority of the multiple burials, the presence of foreign soldiers, victims of an epidemic, remains – at the moment – one of the most serious lines of research awaiting confirmation.

New interdisciplinary research into several perspectives can now be envisaged to strengthen our report. The bio-archaeological study of all the phase V graves must of

course be completed. Further radiocarbon datings are indispensable to confirm the continuity between individual and multiple graves. The study of archaeological materials as a whole, whatever the type of grave, is of considerable importance: notably the analysis of the remains of fabric is liable to provide appreciable information for characterising more precisely the subjects buried in multiple graves.

ACKNOWLEDGMENTS

We are grateful to the many individuals, in particular Dr. Z. Dragoun and Dr. M. Omelka (Department of the Care about Archaeological Heritage, National Institute of Heritage, Prague), Dr. M. Šmolíková (City of Prague Museum), Dr. L. Pechacek, D. Čumlivski and V. Kovar (National Archiv, Prague). This work was supported in part by funds from the La Maison des Sciences de l'Homme d'Aquitaine (2003–2006 et 2007–2010), by the projects Eco-Net 16368 PB, Barrande 19512 ZF and finally by the Ministry of Culture of the Czech Republic (DKRVO National Museum, Prague). Thanks also to Frances Holden for her translation.

REFERENCES

Annales Seminarii S. Norberti Pragae, Tomus I: 1637–1736, Tomus II: 1736–1785, Signature DJ IV 1 and 2.

ANTOINE D., 2008: The Archaeology of "Plague". *Med. Hist. Suppl.* 27: 101–114.

BIRABEN J.-N., 1975: *Les hommes et la peste en France et dans les pays européens et méditerranéens*. EHESS, Centre de Recherches Historiques Mouton, Paris.

BIRKNER R., 1980: *L'image radiologique du squelette*. Maloine, Paris.

BIZOT B., CASTEX D., REYNAUD P., SIGNOLI M., 2005: *La saison d'une peste (Avril–Septembre 1590), Le cimetière des Fédons à Lambesc*. Éditions du CNRS, Paris.

BLAIZOT F., CASTEX D., 2005: Du bon usage des outils anthropologiques à l'étude des sociétés historiques. In: O. Dutour, J.-J. Hublin, B. Vandermeersch (Eds.): *Objets et méthodes en paléoanthropologie*. Pp. 259–279. Comité des Travaux Historiques et Scientifiques, Paris.

BLECKWENN H., 1984: *Die friderizianischen Uniformen 1753–1786*. Hardenberg, Dortmund.

BRUZEK J., SCHMITT A., MURAIL P., 2005: Identification biologique individuelle en paléoanthropologie. Détermination du sexe et estimation de l'âge au décès à partir du squelette. In: O. Dutour, J.-J. Hublin, B. Vandermeersch (Eds.): *Objets et méthodes en paléoanthropologie*. Pp. 217–246. Comité des Travaux Historiques et Scientifiques, Paris.

CASTEX D., 2005: Le cimetière de peste des Fédons: des données anthropologiques aux interprétations. Des particularités démographiques propres au site des Fédons. In: B. Bizot, D. Castex, P. Reynaud, M. Signoli (Eds.): *La saison d'une peste (Avril–Septembre 1590). Le cimetière des Fédons à Lambesc*. Pp. 46–53. Éditions du CNRS, Paris.

CASTEX D., 2008: Identification and interpretation of historical cemeteries linked to epidemics. In: D. Raoult, M. Drancourt (Eds.): *Paleomicrobiology and Past Infections*. Pp. 23–48. Springer, Berlin, Heidelberg.

CASTEX D., BRUZEK J., VELEMINSKY P., SELLIER P., 2007: Epidemic mortality crises of the past: bioarchaeological approach. *Slovenská antropológia* 10, 1: 6–13.

CHAMBERLAIN A., 2006: *Demography in archaeology*. Cambridge University Press, Cambridge.

CUNHA E., SILVA A. M., 1997: War lesions from the famous Portugese Medieval battle of Aljubarotta. *Int. J. Osteoarchaeol.* 7: 596–599.

DEWITTE S. N., WOOD J. W., 2008: Selectivity of Black Death mortality with respect to pre-existing health. *Proc. Natl. Acad. Sci. U. S. A.* 105, 5: 1436–1441.

DRANCOURT M., ROUX V., DANG L. V., TRAN-HUNG L., CASTEX D., CHENAL-FRANCISQUE V., OGATA H., FOURNIER P.-E., CRUBEZY E., RAOULT D., 2004: Genotyping, Orientalis-like Yersinia pestis, and Plague Pandemics. *Emerg. Infect. Dis.* 10, 9: 1585–1592.

DRANCOURT M., ABOUDHARAM G., SIGNOLI M., RAOULT D., DUTOUR O., 2005: Validation de la saisonnalité des décès et authenticité biologique de la nature de l'épidémie. L'apport de la biologie moléculaire. In: B. Bizot, D. Castex, P. Reynaud, M. Signoli (Eds.): *La saison d'une peste (Avril–Septembre 1590). Le cimetière des Fédons à Lambesc*. Pp. 65–67. Éditions du CNRS, Paris.

DUDAY H., 2007: Archaeological Proof of an Abrupt Mortality Crisis: Simultaneous Deposit of Cadavers, Simultaneous Deaths? In: D. Raoult, M. Drancourt (Eds.): *Paleomicrobiology and Past Infections*. Pp. 49–54. Springer, Berlin, Heidelberg.

DUDAY H., 2009: *The Archaeology of the Dead. Lectures in Archaeothanatology*. Oxbow books, Oxford.

ECKERT E. A., 2000: The Retreat of Plague from Central Europe, 1640–1720: A Geomedical Approach. *Bull. Hist. Med.* 74: 1–28.

GOWLAND R. L., CHAMBERLAIN A. T., 2005: Detecting Plague: palaedemographic characterisation of a catastrophic death assemblage. *Antiquity* 79: 146–157.

HANÁKOVÁ H., STLOUKAL M., 1988: *Pohřebiště kolem bývalého kostela Svatého Benedikta v Praze. (The graveyard around former the Church St. Benedict in Prague)*. Národní Muzeum v Praze – Přirodovědecké muzeum, Praha.

HILLS C., 2007: History and archaeology: the state of play in early medieval Europe. *Antiquity* 81: 191–200.

HOLLINGSWORTH M. F., HOLLINGSWORTH T. H., 1971: Plague Mortality Rates by Age and Sex in the Parish of St. Botolph's without Bishopsgate. London, 1603. *Pop. Stud.* XXV, 1: 131–146.

JEČNÝ H., OLMEROVÁ H., 1988: Historie a výzkum staroměstského bloku kolem kostela sv. Benedikta (History and Research of Old Town's House Block around the Church St. Benedict.). In: H. Hanáková, M. Stloukal (Eds.): *Pohřebiště kolem bývalého kostela Svatého Benedikta v Praze*. Pp. 7–24. Národní Muzeum v Praze – Přirodovědecké museum, Praha.

KARGER J. A., 1998: *Die Entwicklung der Adjustierung, Rüstung und Bewaffnung der österreich-ungarischen Armee 1700 bis 1809*. LTR Verlag, Berlin.

KJELLSTRÖM A., 2004: A sixteen-century warrior grave from Uppsala. Sweden: the Battle of Good Friday. *Int. J. Osteoarchaeol.* 15: 23–50.

KREITNER K. F., SCHWEDEN F. J., RIEPERT T., NAFE B., THELEN M., 1998: Bone age determination based on the study of the medial extremity of the clavicle. *Eur. Radiol.* 8: 1116–1122.

LEDERMANN S., 1969: *Nouvelles tables-types de mortalité. Travaux et documents 53*. INED, Paris.

MALLET E., 1835: Notices sur les anciennes pestes de Genève. *Annales d'hygiène publique et de médecine légale, Paris* XIV, 2: 205–221.

MARGERISON B. J., KNÜSEL C. J., 2002: Paleodemographic Comparison of a Catastrophic and an Attritional Death Assemblage. *Am. J. Phys. Anthropol.* 119: 134–148.

MARTINEC V., 1971: *Pohřebiště při kostele svatého Benedikta. (Cemetery of St Benedict's Church). Nálezová zpráva*. Národní památkový ústav, Praha.

MEYER C., 2003: Osteological evidence for the Battles of Zürich, 1799: a glimpse into soldiery of the past. *Int. J. Osteoarchaeol.* 13: 252–257.

MOORREES C. F. A., FANNING A., HUNT E. E., 1963a: Age variation of formation stages for ten permanent teeth. *J. Dent. Res.* 42: 1490–1502.

MOORREES C. F. A., FANNING A., HUNT E. E., 1963b: Formation and resorption of three deciduous teeth in children. *Am. J. Phys. Anthropol.* 21: 205–213.

MURAIL P., BRUZEK J., HOUËT F., CUNHA E., 2005: DSP: a tool for probabilistic sex diagnosis using worlwide variability in hip-bone measurements. *Bulletins et Mémoires de la Société d'Anthropologie de Paris* 17, 3–4: 167–176.

OWINGS-WEBB P. A., SUCHEY J. M., 1985: Epiphyseal Union of the Anterior Iliac Crest and Medial Clavicle in a Modern Multiracial Sample of American Males and Females. *Am. J. Phys. Anthropol.* 68: 457–466.

PAPAGRIGORAKIS M. J., YAPIJAKIS C., SYNODINOS P. N., BAZIOTOPOULOU-VALAVANI E., 2006: DNA examination of ancient dental pulp incriminates typhoid fever as a probable cause of the Plague of Athens. *Int. J. Infect. Dis.* 10: 206–214.

RAOULT D., DUTOUR O., HOUHAMDI L., JANKAUSKAS R., FOURNIER P. E., ARDAGNA Y., DRANCOURT M., SIGNOLI M., DANG. L. V., MACIA Y., ABOUDHARAM G., 2006: Evidence for louse transmitted diseases in soldiers of Napoleon's grand army in Vilnius. *J. Infect. Dis.* 193: 112–120.

SCHEUER L., BLACK S., 2000: *Developmental juvenile osteology*. Elsevier Academic Press, London.

SCHMITT A., 2002: Estimation de l'âge au décès des sujets adultes à partir du squelette: des raisons d'espérer. *Bulletins et Mémoires de la Société d'Anthropologie de Paris* 14, 1–2: 51–73.

SCHULTZ V., 1901: *Contributions à l'histoire de la peste en Tchéquie dans les années 1531–1746 à partir des archives du Musée tchèque du Royaume de Bohême*. Prague.

SELLIER P., 1996: La mise en évidence d'anomalies démographiques et leur interprétation: population, recrutement et pratiques funéraires du tumulus de Courtesoult. In: J.-F. Piningre (Ed.): *Le tumulus de Courtesoult (Haute-Saône) et le Ier Age du Fer dans le bassin supérieur de la Saône*. Pp. 188–200. Éditions de la Maison des Sciences de l'Homme (DAF), Paris.

STROUHAL E., 2007: Plague Epidemics in Czech Countries. In: M. Signoli, D. Chevé, P. Adalian (Eds.): *Peste: entre épidemies et sociétés*. Pp. 49–52. Firenze University Press, Firenze.

SVOBODA P., 2004: The Health of the Population and Health Policy in 19th Century Bohemia: The case of Asiatic Cholera (1830s–1900s). In: L. Abreu (Ed.): *European Health and Social Welfare Policies*. Pp. 200–215. Compostela Group of Universities and the Phoenix TN, University of Technology, VUTIUM Press, Brno.

THEINHARDT M., BENEŠOVSKÁ K., DRAGOUN Z., HORYNA M., PEŠEK J., PETRASOVÁ T., PRAHL R., ŠVÁCHA R., 2005: *Prague. L'art et les grandes civilisations*. Citadelles and Mazenod, Paris.

UBELAKER D., 2007: The Impact of Plague in Colonial Period Ecuador: The Skeletal Evidence. In: M. Signoli, D. Chevé, P. Adalian (Eds.): *Peste: entre épidemies et sociétés*. Pp. 131–136. Firenze University Press, Firenze.

WALDRON H. A., 2001: Are plague pits of particular use to palaeoepidemiologists? *Int. J. Epidemiol.* 30: 104–108.

WEBER O., 1896: *Occupation Prags durch die Franzosen und Baiern 1741–1743*. J. G. Calve, Prague.

Dominique Castex
Jaroslav Brůžek
Pascal Sellier
Maryelle Bessou
Stéphanie Sève
CNRS, UMR 5199 PACEA
Anthropologie des Populations Passées et Présentes
Université Bordeaux 1
33405 Talence
France
E-mail: d.castex@pacea.u-bordeaux1.fr
E-mail: j.bruzek@anthropologie.u-bordeaux1.fr
E-mail: p.sellier@anthropologie.u-bordeaux1.fr
E-mail: m.bessou@anthropologie.u-bordeaux1.fr
E-mail: stephanie.seve@yahoo.fr

Petr Velemínský
Miluše Dobisíková
Department of Anthropology
National Museum
Václavské náměstí 68
115 79 Prague
Czech Republic
E-mail: petr_veleminsky@nm.cz
E-mail: miluse_dobisikova@nm.cz

Hedvika Kuchařová
Library of Royal Canonry of
Premonstratensians at Strahov
Strahovské nádvoří 1/132
118 00 Prague
Czech Republic
E-mail: hedvika@strahovskyklaster.cz

Jean-marie Lourenço
333 40 Queyrac
France
E-mail: jean-marie.lourenco@onf.fr

Libor Jůn
National Museum Archive
National Museum
Václavské náměstí 68
115 79 Prague
Czech Republic
E-mail: libor.jun@nm.cz