CITIZENS BURIED IN THE 'SINT JANSKERKHOF' OF THE 'SINT JANS' CATHEDRAL OF 's-HERTOGENBOSCH IN THE NETHERLANDS ca. 1450 and 1830-1858 AD

G.J.R. Maat, R.W. Mastwijk and M.A. Jonker

BARGE'S ANTHROPOLOGICA

Nr. 8

Leiden

2002

Published by:
Barge's Anthropologica
Leiden University Medical Center
P.O. Box: 9602
2300 RC, The Netherlands

ISBN: 90-806456-3-X

CITIZENS BURIED IN THE 'SINT JANSKERKHOF' OF THE 'SINT JANS' CATHEDRAL OF 's-HERTOGENBOSCH IN THE NETHERLANDS, ca. 1450 and 1830-1858 AD

G.J.R. Maat*, R.W. Mastwijk* and M.A. Jonker**
* Barge's Anthropologica, Department of Anatomy, LUMC
** Department of Medical Statistics, LUMC

SUMMARY

A physical anthropological study was performed on the excavated remains of citizens buried in the north-eastern part of the so-called 'Sint Janskerkhof', the cemetery of the Saint John's Cathedral of the city of 's-Hertogenbosch. The excavation was carried out by the archaeologists of the city in 1984. Except for eight late mediaeval skeletons, the collection of 316 skeletons dated from 1830-1858 AD. A low standard of living, widespread unemployment and the outbreaks of many epidemic diseases characterized this short time span in the post-Napoleonic Period. From documentation it was known that the interred had belonged to the lowest social class of the population. The skeletal evidence found on the skeletons corresponded well with this historical image. The osteological results were compared with those of other skeleton collections from various periods of other Dutch cities. In many ways they confirmed the expected poor nutritional and health performance of the citizens. This outcome was strongly corroborated by the extracted data: the age at death of 30% of the buried was less than 20 years, while the average age at death of adults over 20 years of age was 42 years. The average stature of males was almost the lowest seen in the known history of the Low Countries (169.6 cm), at the same time the overall caries frequency of the inspected teeth was the highest (21%). Mechanical traumas were seen on a large scale, at least in 20% of the skeletons, and non-specific hematogenous infections were found in 11% of the cases. Of the adults 7% had suffered from the deficiency disease rickets. The frequency of Diffuse Idiopathic Skeletal Hyperostosis, the affection of the 'well-off', was only 11%. Copper stains on the skeletons reflected different patterns of distributions of interred objects/gifts between males and females, and between non-adults and adults. A distinct cluster of burials for premature and small children, suggesting a separate area of non-consecrated earth in this catholic cemetery, was found.

INTRODUCTION

During the period June 25 to August 7 1984, the Municipal Archaeological Service of the city of s'-Hertogenbosch archaeologically surveyed the so-called north-eastern sector of the 'Sint Janskerkhof' (Saint John's cemetery) of the city (Figure 1). Originally, the cemetery had almost completely surrounded the church, the presently called 'Sint Janscathedraal' (Saint John's Cathedral; Figure 2 and 3). The density of interments in the burial place appeared to be extremely high (see Figure 4). Generally the coffins had been deposited directly on top of each other. Burials had been dug to a depth of 2 meters below ground surface. A total of 421 grave numbers were issued. Most of them related to one or more individually distinct skeletons (N=316), others to assemblages of commingled bones (N=72). In some cases no remaining skeleton material was present for examination (N=60). Because of frequent burying and reburying activities in the past, also many scattered, out of context, skeleton parts were found.

The excavation was supervised by the city archaeologists Prof. H.L. Janssen (1988) and E. Nijhof. W.H.M. Bouts (1984) took special care of the recovery of the skeletal material, while Tj. Pot studied the recovered human dentitions (Pot, 1988). After cleaning, marking and screening of the skeletal material at the depot of the Municipal Archaeological Service of s'-Hertogenbosch by W.H.M. Bouts and R.W. Mastwijk, the skeleton remains were transported on January 1 1999 to Barge's Anthropologica of the Department of Anatomy of the Leiden University Medical Center for further examination.

During the same period of time, from 1992 on, M. Portegies (1999) performed a most interesting study on the history of the graveyard. His consultations of the many historical records and archives produced a fine review for comparison with the results of the physical anthropological laboratory investigations. The study revealed for instance that 86% of the citizens deposited in the cemetery, had actually been buried in the excavated north-eastern sector under study. These people had been from the lower/lowest social class of the city community. For their funerals the cheapest possible fir coffins and palls had been ordered. In the last years that the cemetery had been in use, 60% of the dead had been buried by the local poor relief authorities. The dead originated from the so-called 'Groot Ziekengasthuis" (Main Infirmary; 72% of the adults), the 'Kruisbroederskerk' (church of the Crutched Friars) and the 'Sint Jacobskerk' (Saint Jacob church; the church of the poor). As usual in Christian cemeteries people had been interred with their heads to the west in order to face the east during Judgment Day's resurrections. Their arms were extended along their body or their hands were folded in their lap as for praying.

Although the cemetery had been used for many centuries, almost all the exhumed human material dated from the first half of the 19th century (Portegies, 1999). On the basis of archives and of small medals bearing a religious emblem which were found on the skeletons, the dating could further be reduced to the period 1830-1858 AD. Because of the recorded frequent clearance of individual graves, usually within 5 to 10 years, almost all bones from before 1830 originated from charnel pits or from reburial practices. Eventually in 1858, long after the promulgation of a new law on burial practices by Napoleon in 1804, a law which was again proclaimed by the Dutch King William I in 1827, the cemetery was closed.

Eight extra skeletons dated from the Late Mediaeval Period (ca. 1450 AD; personal communication Janssen and Van de Vrie, 2001). Except for the record (Table 2), they will not be dealt with in the following analysis.

MATERIALS and METHODS

For an impression on the amount of processed skeleton material of the s'-Hertogenbosch collection, a total count of inspected major bones from adults is summarized in Table 1.

A review of the 421 grave numbers (G- ..) and associated skeletons can be found in Table 2. If more than one skeleton could be associated with a grave number (e.g. grave number 191), a digit 1, 2 or 3 was added to the original G-number to identify the individually distinct skeletons (e.g. 191.**1**, 191.**2** and 191.**3**). The table also shows the main demographic data of the osteological analyses.

Only individually distinct skeletons (N=316) were processed for physical anthropological and paleopathological analyses. Although recorded in Table 1, assemblages of commingled bones (N=72) were not taken into account for further analyses. The same holds for cases in which no remaining skeleton material was present for examination (N=60).

Most skeletons were anatomically incomplete. Their degree of completeness was recorded and can be found in the individual physical anthropological reports. Many bones showed postmortem fractures. If possible they were manually reconstructed. The texture of the bone tissue was moderate to good.

Sex, age, dental and stature determinations were done in compliance with departmental protocols (Maat et al., 1999) and with the recommendations of the Workshop of European Anthropologists (WEA, 1980).

Analysis of the non-metrical morphological degree of sexualization of the pelvis and cranium was executed by determining the degree of feminine or masculine development by means of scoring a series of anatomical sex features (Maat et al., 1997). From the added up weighted scores and their added up weight factors, the quotient the so-called 'degree of sexualization' was calculated. The degree of sexualization may range from hyperfeminine (-2), via indifferent (0) to hypermasculine (+2). See Table 2. In the extremely rare case that a pelvic and cranial sex diagnosis differed, preference was given to the pelvic diagnosis for reasons of sex related functional anatomy.

Further analysis of sex was done by measuring the antero-posterior diameter of femurs with a sliding caliper (APD; MacLaughlin and Bruce, 1986). For a test we introduced three new but related measurements: the APD-max, the TIB and the TIB-max. The APD is measured perpendicular to the axis of the knee. It is taken at the level of largest diameter along the linea aspera. The APD-max is taken at the same level by rotating the femur shaft to its widest diameter. In a similar way the antero-posterior diameter (TIB) and the maximum TIB (TIB-max) of tibias is taken. Here the level of measurement is the opening of the nutrient foramen.

Methods for diagnosing skeletal age at death differed for various phases of aging. For children, dental development and ossification of the axial skeleton were used (Ubelaker, 1978; Maat et al., 1999). From the age of twelve years on, epiphyseal fusion of long bones was considered to be the main age indicator (Brothwell, 1981). For adults the so-called Complex Method of Acsády and Nemeskéri (1970) was applied. In this method age characteristics are read from: the degree of increasing obliteration of the endocranial sutures, the changes of the face of the pubic symphysis, the deterioration of the spongiosa in the proximal femur and humerus. If less than three of the latter age indicators were present, the estimated age at death interval was derived by means of seriation of molar attrition with respect attrition scores of individuals with adequate numbers of skeletal age indicators (Maat and Van der Velde, 1987). For reasons of computing all individuals were assigned to a 10-years age at death interval (e.g. interval 0 = 0-9 years; interval 1 = 10-19 years; interval 2 = 20-29 years, etc). See Table 2. In general it should be kept in mind that given ages are skeletal/biological ages, not calendar ages. Both are expressed in years. They do not necessarily coincide exactly, although they mostly are equivalent.

Stature of adults was calculated after Breitinger for males and after Trotter and Gleser for males and females (Breitinger, 1937; Trotter and Gleser, 1958, 1970) See Table 2. Breitinger's equation is said to produce a more realistic stature diagnosis for European males "born north of the Alps" (Wurm, 1986).

Cranial and long bone measurements were taken as defined by Knussmann (1988).

For the understanding and interpretation of the dental data, the following definitions and abbreviations are relevant:

N erup:	the assessed number of erupted regular teeth on the basis of the available space for socket positions in the jaws (maximum of 32; minimum of 28 in case all third molars failed to develop).
N insp:	the number of inspected teeth.
N miss. pos:	the number of missing jaw (socket) positions and related teeth.
N ret:	the number of congenitally absent or unerupted teeth.
N AM loss:	the number of antemortem losses.
N PM loss:	the number of postmortem losses.
N supernumerary:	the number of supernumerary teeth.
N car:	the number of teeth with carious lesions (NOT the total number of lesions).
N absc:	the number of abscesses.
N fistulas:	the number of fistulas.
Alveolar atrophy:	the degree of alveolar atrophy scored after Brothwell (1981).
Calculus:	the degree of calculus/tartar formation scored after Brothwell (1981).
Periodontitis:	the degree of periodontitis i.e., interalveolar atrophy with pitting and reactive bone/crest formation (none, light, medium and considerable).

Antemortem loss (%): $$\frac{\text{AM loss} \times 100}{\text{N erup} - \text{N miss.pos}}$$

Postmortem loss (%): $$\frac{\text{PM loss} \times 100}{\text{N erup} - \text{N miss.pos} - \text{AM loss}}$$

Caries frequency (%): $$\frac{\text{N car} \times 100}{\text{N insp}}$$

Abscess frequency (%): $$\frac{\text{N absc} \times 100}{\text{N erup} - \text{N miss.pos} - \text{AM loss}}$$

DM(F) Index (%): 'Decayed-Missing (-Filled) Index': percentage of carious or antemortem lost teeth of all alveolar/socket positions with inspected or antemortem lost teeth.

$$\frac{(\Sigma N\ car + \Sigma AM\ loss) \times 100}{\Sigma N\ erup - \Sigma N\ miss.pos - \Sigma PM\ loss}$$

All percentages have been calculated from so-called 'possible cases' i.e., from examinable specimens. Only unequivocal observations were taken into account. All percentages represent 'prevalence at death'. They may differ from frequencies as they were in the 'living population' of those days. Comparisons made in the 'Discussion' paragraph were only made if calculation methods used in literature were compatible.

Paleodemographic analyses and paleopathological diagnoses were corroborated by current literature and textbooks (e.g. Steinbock, 1976, Ortner, 1985, Waldron, 1994, Mays, 1998, Aufderheide and Rodriguez-Martin, 1998). Criteria for the diagnosis of the arthropathies Degenerative Disc Disease (DDD), vertebral- and peripheral osteoarthritis (vOA and pOA), Diffuse Idiopathic Skeletal Hyperostosis (DISH), Von Bechterew's disease, Reiter's syndrome and psoriatic osteoarthritis were those of Rogers and Waldron (1995), supplemented with a some minor conditions by Maat et al. (1995). Only unequivocal cases from skeletons having adequate numbers of vertebrae from all three spinal levels (cervical, thoracic and lumbar) were taken into account.

Finally stains on the bones from copper objects were recorded. Percentages of positive staining were calculated from 'possible' cases. Only distinct and systematic patterns of staining on the skeletons were statistically processed. With the term 'neck region' is meant a cluster of the following skeleton parts: the clavicles, the scapulas, the sternum, the upper ribs, the cervical vertebras and the upper thoracic vertebras. With the term 'hand/wrist' is meant the cluster: distal end of ulna and radius, plus hand and wrist bones.

RESULTS

From the 421 grave numbers a total of 316 individually distinct skeletons could be singled out for inspection. Main results on the sex, age at death, stature and paleopathology of the related individuals have been listed per individual in Table 2. In addition, every individual was plotted on a map of the burial place (Figure 4). Colors indicate sex and age. A summary of the main demographic data for the entire collection can be found in Table 3.

From 237 skeletons the sex of the related adults could be determined. The male / female ratio appeared to be 52 / 48 (N = 237). In almost all cases the sex of the individual could be settled by assessing the 'degree of sexualization' of pelvis and/or cranium. An attempt was made to achieve some additional sex diagnoses for skeletons missing the pelvis and cranium by using the average antero-posterior diameter (APD) and the maximum APD (APD-max) of left and right femurs. The same was done for the antero-posterior diameter (TIB) and the maximum TIB (TIB-max) of left and right tibias. Additional sex diagnoses were only accepted if antero-posterior values fell outside the common range of overlap of both sexes. Lower or higher values were diagnosed as female or male respectively. See Figures 5, 6, 7, and 8. The area of overlap for male and female values for the APD, APD-max, TIB and TIB-max were respectively: 24.0-30.5 mm, 25.0-30.1 mm, 26.6-33.5 mm and 27.2-33.6 mm. All attempts resulted in only one additional sex diagnosis out of 7 sets of femurs and 3 sets of tibias from skeletons of unknown sex. The one extra diagnosis appeared to be a male (skeleton G-204).

For 229 of the individuals the age at death could be assigned to a specific 10-year age at death interval (e.g. interval 0 = 0-9 years, 1 = 10-19 years, 2 = 20-29 years, etc). It should be mentioned here that the 27 adults, who originally had such a wide age range that it covered more than one 10-year interval, could be assigned to a particular 10-year interval after seriation of their molar attrition scores (see Materials and Methods).

In the cemetery the percentage of individuals younger than 20 years was almost 30% (68 children), of those older than 20 years a little over 70% (161 adults). Ages varied from before natural birth (-0.4 years i.e., premature) to 70 years (the maximum determinable skeletal age). See Table 2. The average age at death with children included in the calculation was 32 years (S.D. 24.8 years). However the age at death of those older than 20 years, the adults, was 42.2 years i.e., 43.4 years and 41.1 years for 83 males and 74 females respectively. The age at death distribution in 10-year intervals of all individuals of known age is shown in Figure 9. Note the 7 cases of premature death. For males and females, teenagers of known sex included, the distributions are shown in Figure 10 and 11. What is remarkable is the high death rate for females in the 20-29 years age interval. In addition, a more detailed age at death distribution, in 5-year age intervals, is given for children, teenagers of unknown sex included. See Figure 12. This showed the presence of premature deaths and a very high death rate in the 0.0-4.9 age interval. These premature and small children formed a cluster in the transition area between archaeological pit numbers III and IV of the cemetery (Figure 4).

To determine the cranial index, proper measurements could only be taken from intact crania i.e., from 24 male and 18 female crania. Overall, the average index was 78.8 (S.D. 3.71). According to Student's t-test for equality of means, the difference between males and females was not statistically significant ($p = .988$).

Stature of males could be calculated by means of the equations of Breitinger (1937) and of Trotter (1970) for respectively 82 and 88 individuals. The resulting average statures were 170.3 cm (S.D. 6.5 cm) and 169.6 cm (S.D. 4.4 cm). Stature of females was calculated by means of the equations of Trotter and Gleser (1958) for 84 females. Their calculated average stature was 160.5 cm (S.D. 6.3 cm). According to Student's t-test for equality of means, the difference in height between males and females was statistically extremely significant ($p = 0.00$). Based on the calculations of Breitinger (1937) and Trotter and Gleser (1958), the sex dimorphism between males and females showed a difference in stature of 9.1 cm. Similar comparisons could be made by using the maximum femoral lengths. In that case average maximum femoral length for males and females was respectively 45.7 mm (S.D. 2.52 mm; $N = 67$) and 42.8 mm (S.D. 2.49 mm; $N = 53$). According to Student's t-test for equality of means, the difference in maximum femoral length between males and females, 2.9 mm, was again statistically extremely significant ($p = 0.00$).

A total count of teeth from the adults and a review of their dental status in percentages is given in Table 4 and 5. It appeared that the overall degree of alveolar atrophy, calculus (tartar formation) and periodontitis was slight to medium. An attempt was made to see if there was any statistical correlation between the presence of alveolar atrophy, calculus and periodontitis. The correlations could be checked for 122 individuals. Only for the presence of calculus and periodontitis there appeared to be a statistically significant and acceptable correlation (Spearman's test: $p = 0.00$; correlation coefficient .51). Dental wear channels from clay pipe smoking were found in 31 of the 109 inspectable adults (28%; 1.8 wear channel per smoker; Table 8). Of the inspectable males and females respectively 44% and 12% showed these distinct changes.

Analysis of dental attrition at the occlusal plane of the molars revealed the usual and steady increase in degree of attrition with increasing age ($N = 60$). Also apparent were the natural differences in attrition between M1 and M2, and between M2 and M3, representing differences of ca.6 years in functional age between them due to their eruption sequence. Figures 13, 14 and 15 show the relationship between occlusal attrition and age for the first (M1; N=56), the second (M2; N=60) and the third molar (M3; N=50). The following linear regression equations expressed that same relationship:

Degree of attrition of M1 = 1.878 + (0.358 x age interval)
Degree of attrition of M2 = 1.480 + (0.302 x age interval)
Degree of attrition of M3 = 0.844 + (0.376 x age interval)

The general health status of the early 19th century population and its tendency to contract mechanical traumas (e.g. fractures), infections, deficiency diseases, tumors, arthropathies and anomalies was reflected in the frequencies of their pathological changes. See Table 6-10.

Traces of copper objects, which had been interred with the dead, had left green stains on the surface of the bones. Percentages of positive staining were calculated from 'possible' cases. Individuals younger than 20 years of age, showed stains on their vault (11%, N=38), on the bones of their neck region (13%, N=45) and on their pelvis (8%, N=52). Only one (premature) child had a hand/wrist stain (N=17). No statistically significant differences were found between children younger than 5 years and non-adults of 5 to 20 years of age. Adult males and females showed a significant difference in frequency of stains on their vault (respectively 2% and 13%, N=64 and 67, p=.017) and on their sacrum (respectively 4% and 14%, N=77 and 71, p=.04).

They showed a high, but a statistically non-different frequency of stains in the neck region (respectively 8% and 10%), on their pelvis (respectively 21% and 31%, N=96 and 97) and on the cluster 'pelvis plus hand/wrist' (respectively 26% and 34%, N=100 and 101). The cluster 'pelvis plus hand/wrist' frequencies were statistically different between individuals younger and older than 20 years (respectively 9% and 29%, N=57 and 211, p=.002).

DISCUSSION

The excavated deceased were buried in 's-Hertogenbosch after the French occupation of 1794-1814 AD, the so-called 'Bataafse en Franse tijd', and before the oncoming Industrial Revolution which started in The Netherlands ca. 1860-1870 AD. Of course, the dead represent life prior to the time of their burial, life as it was during the transition from the 18th to 19th centuries and especially life as it was during the first half of the 19th century itself. Within this time span the so-called Belgian Revolt of 1830-1834 AD occurred, which led up to the independence of the most southern part of the Low Countries, Belgium. On a national scale the period was characterized by an intensification of the ongoing urbanization process (De Beer, 2001). This resulted in ever increasing numbers of citizens. At that time, the city of 's-Hertogenbosch, the capital of the province of North-Brabant had 20,000 inhabitants!

The period of French occupation with its many Napoleonic wars had drained the economic resources of the country. As a result the standard of living was very low (Portegies, 1999, De Beer, 2001). Social life was characterized by widespread unemployment. Also from a medical point of view the community had to endure misfortune. In the relative short period under investigation many outbreaks of epidemic diseases were recorded: cholera (1830-1850), measles (1829, 1855; morbilli; 'mazelen'; still the main cause of child death in developing countries), chicken pox (1831, 1852; varicella; 'water-/ kinderpokken'), scarlet fever (1835; scarlatina; 'roodvonk'), whooping cough (1846; pertussis; 'kinkhoest') and typhus (1850; febris typhoidea; 'tyfus'). Malaria, endemic in the region, showed serious upsurges, for instance in 1831. In the graves the bodies of people who died from (contagious) epidemic diseases were usually covered with quicklime ('ongebluste kalk') in an attempt to prevent further spread of such diseases in the community. In addition to all this a dramatic series of potato crop failures occurred during the period 1845-1855. As a matter of course the lower social class and the poorest of the community, the people who had been buried in the excavated north-eastern section of the cemetery, suffered more than anybody else did from all these health insults.

Sex

The sex ratio of the adults as determined from their skeletons (Table 3; male / female = 52 / 48), appeared to be almost the same as predicted by the burial records for the period 1851-1858 (Portegies, 1999; 50 / 50). The balance itself is a natural one for civilians. Neither the slight surplus of males, nor the distribution of males in the north-eastern section of the cemetery indicated any unusual interment activity (Figure 4). Interments due to military activities, for instance related to the Belgian Revolt of 1830-1834 AD and the ten-day military campaign of 1831, the so-called 'tiendaagse veldtocht', would certainly have resulted in a male dominated area in the cemetery. This could easily have been the case, since most of the wounded soldiers of that campaign were taken care of in the local Main Infirmary ('Groot Ziekengasthuis'). Many of them were buried in the Saint John's cemetery ('Sint Janskerkhof'), but apparently not in the excavated section. Besides, no military activities related peak in male deaths for the 20-29 or 30-39 years age intervals was seen in the age at death distribution for males (see Figure 10). Also no distinct 'military' mechanical traumas, such as gunshot and stab injuries, were found on the skeletons (see 'Pathology').

To achieve additional sex diagnoses for incomplete skeletons that were missing pelvis and cranium, the antero-posterior diameter (APD) and the maximum APD (APD-max) of femurs, and the antero-posterior diameter (TIB) and the maximum TIB (TIB-max) of tibias was processed. The effort produced very little spin-off as can be seen in Figures 5, 6, 7, and 8. Only one more male diagnosis could be added to the 236 sex diagnoses based on pelvis or cranium. The feasibility of the APD sex determination method was tested before on the skeletal remains of 204 late mediaeval citizens from the city of Dordrecht (Maat et al., 1998). In that population four diagnoses, three females and one male, were added to the 200 diagnoses based on pelvis or cranium. In that case the common sex range of APD overlap was 25-31 mm, now it was 24-30.5 mm.

Age at death

For details see Table 3 and 11. The average age at death of the deceased over 20 years of age was 42.2 years overall, 43.4 years for males and 41.4 years for females. According to the burial records of the church for this section of the cemetery, average age at death for adults during the transition from 18th to 19th century was 47 years (Portegies, 1999). From other skeleton studies we know that in various periods prior to the first half of the 19th century, age at death of adults varied. See Table 11. Nevertheless, the average for the period immediately proceeding the 's-Hertogenbosch burials seems to have been much higher, 56-60 years (Baetsen, 2001). It seems plausible to assume that at least part of the dramatic drop in age at death in 's-Hertogenbosch after the 18th century could be assigned to the aftermath of the Napoleonic Period with its decline in socio-economic and health conditions. As a consequence, average age at death reverted to even slightly less than during the Late Mediaeval Period (Table 11). But the skeleton analysis did not affirm the extremely low average age at death of 25 years for deceased adults as calculated on the basis of dental attrition by Pot (1988). Precondition for the latter approach was, that the functional molar attrition rate of children between 6 and 12 years could be extrapolated to the elderly. It assumed that mastication force and diet would stay the same after the age of 12 years (Maat, 2001).

Despite atypical demographic profile deviations due to small samples sizes, the overall age at death distribution in 's-Hertogenbosch was basically not different from earlier populations of other cities in The Netherlands (Figure 9). Only the late mediaeval population of Delft seemed to show an uncommon dip of average age at death in the 30-39 age interval. However that sample size was rather small. Interesting demographic profiles to compare with were derived from:

--- the late mediaeval population of Dordrecht (Maat et al., 1998; N = 224; Figure 4), of Gorinchem (Maat and Mastwijk, 2000; N = 22; Figure1) and of Delft (Onisto et al., 1998; N = 47 and 38; Figure 6),

--- the 17th-18th century population of Breda (Maat and Mastwijk, 2000; N = 66; Figure 2),

--- the 18th - early 19th century population of Zwolle (Aten, 1992; N = 226; Figure 12-13; Bouts et al., 1992; N = 109; Figure 28, 30) and of Alkmaar (Baetsen, 2001; N = 243; Figure 4.5).

Probably the most remarkable finding in the case of 's-Hertogenbosch was the large number of excavated small children, especially of prematurely stillborn children. Their presence in the collection is not only attributable to the fact that they had been buried in surveyed section of the cemetery, but in particular to the care and skill of the excavators. Skeletons of the very young are easily overlooked or mistaken for animal remains, for bones of domesticated fowl in particular. Children and youngsters, all younger than 20 years of age, constituted 30% of the deceased as determined from the skeletal remains (Table 3). From the burial records of the same period it varied between 25 and 45% (Portegies, 1999). According to Waldron (1994), this should precisely be the case in pre-industrial societies. This percentage was also seen in the17th-18th century population of Breda (29%; Maat and Mastwijk, 2000). The 18th - early 19th century material from Alkmaar came very close with 24% (Baetsen, 2001). In all other studies listed above the percentage was much lower. The latter does not necessarily mean that it was the result of the overlooking of small and badly decomposed bones during excavation. It could just as well be due to selective interment. It was not unusual to bury children in a special, later coincidentally not excavated, section of a cemetery (Arcini, 1999). Such a special place was also suggested for 's-Hertogenbosch by Portegies (1999), the so-called 'limbus infantum' for stillborn and postnatal deaths. But, although a clear borderline strip between consecrated and non-consecrated earth in the form of a 'limbus infantum' was not found, a distinct cluster of premature and small children was seen in the transition area between archaeological pit number III and IV of the cemetery (Figure 4). A breakdown of deceased younger than 20 years of age into 5-year intervals showed that it was especially the children of the 0.0-4.9 interval, which caused the expected high death rate for children in this pre-industrial society. They were the most vulnerable to health insults (Figure 12). For comparison: a similar distribution pattern was found in the burial records of the church for the period 1782-1785 by Portegies (1999, Table 17). He also listed the most frequently noted 'causes': convulsions (39%), stillborn or delivery (20%), smallpox (14%), others (27%).

For the adults separate distribution profiles were made for males and females (Figure 10 and 11). The male distribution showed hardly any indentations. The profile was not unusual and it was almost similar to the graph reconstructed from the church record data for the year 1804 (Portegies, 1999, Figure 10). The female distribution showed a remarkably high death rate for the 20-29 years interval. In the same church records this peak was also found, but a little delayed, in the 30-39 year interval. The latter phenomenon was also noted in late mediaeval Dordrecht (Maat et al., 1998). It could be an indication of increased risk for females. Was it related to pregnancies and deliveries?

Cranial Index

The number of skulls of which the cranial index could be determined was very small (N = 42). The average index of males and females was 78.8 (S.D. 3.71). This fell into the mesocranic range according to Knussmann (1988). Mesocranic means that the breadth/length ratio, the form of the skull as viewed from above, was common for European standards. The index should not be interpreted as a reliable indicator of ancestry, since in studies based on vast samples sizes of immigrants from various countries to the United States during the beginning of the 20th century, skull form proved to be extremely dependant on non-genetic factors (Boas, 1912). Even after a short time span, the skull form of growing children responded strongly to a change in environment (geographical position, climate).

Stature

For details see Table 3, 12 and 13. In accordance with opinion of Wurm and Leimeister (1986; see the paragraph on 'Methods'), we held the view that a calculated stature assessment after the equations of Breitinger (1937) would produce a more realistic estimate for the 's-Hertogenbosch males than an assessment after the equations of Trotter (1970). Breitinger's reference group of

2400 German men seemed to be more suitable for the neighboring Low Countries, than Trotter's more heterogeneous reference group of less related 'White American' men. In addition to such considerations on the suitability of the used reference population, another methodological cause of bias in stature assessment should be mentioned. Average stature of a group is calculated from a series of individual statures. But the individual statures are almost always extracted from sets of equations, which are subject to variation, since the composition of the used set depends on the availability of skeleton parts. Consequently, most individual statures are based on measurements taken from different combinations of long bones (Onisto et al., 1998). Only the direct processing, comparison and interpretation of raw long bone lengths, for instance the maximum femoral lengths, will neutralize such objections. Nevertheless, a calculated stature is easier to comprehend than a maximum femoral length. Since most historical records to compare results with are of males (conscripts, militias), most of the presented tables and diagrams show male data only. For reasons of comparability, only virtual statures of 'young' adult males were used in Figure 16 and Table 12. The virtual stature is the stature an adult male is supposed to have had at the end of his growth period before he starts shrinking by aging. These statures processed were:

--- Calculated statures. On purpose, they were not compensated for shrinkage due to aging (Breitinger, 1937; Trotter and Gleser, 1958). They should reflect 'young adult stature'.
--- In situ (in the grave) measured statures. Here, postmortem cadaveric stretch was compensated for by missing skin on the vault and heel (Maat, 1993).
--- Cadaveric statures. They were compensated for 2 cm postmortem stretch according to Pearson (1899), Martin and Saller (1957), Trotter and Gleser (1958) and Maat (1993).
--- Live statures of 'young adults'. These were true statures. No changes should be needed.

In 's-Hertogenbosch of the first half of the 19th century, the calculated stature of adult males and females was 169.6 and 160.5 cm respectively. The difference between both sexes, usually about 9-13 cm, was 9.1 cm (Oppers, 1966; Van Wieringen, 1978). The assessed stature of 169.6 cm for adult males corresponded well with the recorded average height of 169.0 cm of adult males who were enrolled during the same period for the militias of seven Dutch cities in 1825 AD (Oppers, 1966; N=382). The statures found also agreed with the documentation that standard coffin lengths in 's-Hertogenbosch could stay as they were prior to the 19th century (Portegies, 1999). Stature is known to be a reliable indicator of the general health condition and thus of the socio-economical and hygienic status of a community (Oppers, 1966; Van Wieringen, 1978; Maat, 1984, 1993; Fredriks, 2000, De Beer, 2001). If compared to data on the Dutch population from other periods, and if it is taken into account that the buried males had ended their period of growth ca. 20 years before they died at an average age of 43 years during the period 1820-1838, it was clear that the men from 's-Hertogenbosch were not yet engaged in the oncoming dramatic rally of ever increasing statures which would accompany the Industrial Revolution in the Netherlands. See Figure 16 and Table 12. Indeed as stated above, the stature of these men from the lowest social class showed that they had grown in the post-Napoleonic Period with its deplorable socio-economic and hygienic conditions (Portegies, 1999, De Beer, 2001). Unemployment, urban overcrowding, food shortages, protein deficient foodstuffs, juxtaposed water wells and sewage pits were the rule. Such hygienic conditions were also reflected in the relative high frequency of non-specific hematogenous infections (see below). The same figure and table also showed that males from the city of Leiden, who had their growth period between 1880 and 1930 and who died between 1947 and 1970, apparently had suffered from such disadvantageous growth conditions up to turn of the 19th to the 20th century (Figure 16 and Table 12; Maat, 2001). Indeed, the population of Leiden was known for it's lasting poverty and unemployment.

Apart from some variation between city communities of the Low Countries, the general trend in stature development through the ages, as tentatively represented in Figure 16, showed a distinct temporary decrease of male (and female) stature. The sag seemed to start in the Late Mediaeval Period, dropped to its lowest levels during the 17 and 18th centuries, and was followed by a sharp increase in stature during the 20th century. Wurm (1992) recorded an indication of a more or less similar process for Germany. Maximum femoral lengths, unfortunately only not available for the 20th century, showed the same sagging during the 17th and 18th centuries (Figure 17). Surprisingly the dip coincided with a period of economic prosperity in the Low Countries, the so-called 'Golden Age', the age of colonial expansion. But in terms of growth and stature, 'the man in the street' did apparently not profit from it. He had to wait for the spin-off of the Industrial Revolution around 1860-1870 AD. The following catch-up in growth, the so-called secular trend in stature during the second half of the 19th and the flourishing 20th century, produced unprecedented dimensions in standing living height (Oppers, 1966; Van Wieringen, 1985, Roede and Van Wieringen, 1986, Fredriks et al., 2000). It is interesting to notice that the well nourished canons of the Saint Servaas Basilica at Maastricht, who belonged to the highest social class of western Europe, were very tall in comparison with their contemporaries of the Late Mediaeval Period. See Figure 16 and 17 (Janssen and Maat, 1999).

Teeth

For details see Table 4, 5 and 14. Although usually many teeth are lost during the stay of the body in the grave or afterwards during excavation, cleaning and transport, postmortem tooth loss in 's-Hertogenbosch was only 18.6%. If compared to other excavations, the percentage was a low. In a similar manner to the successful recovery of the skeletons of premature children (see above), it indicated that the care taken by the archaeologists during the handling of the human remains had been adequate.

Antemortem loss, a lesion typically due to caries, was 16.5% i.e., 4 teeth per individual (if not compensated for missing socket positions, 3 per individual according to Pots, 1988). Such a high value, together with a caries frequency of 20.7% (3.4 teeth per individual; if not compensated for missing socket positions 2 per individual according to Pots, 1988) and a DM(F) index (Decayed Missing Filling index) of 36.2% (!), was a strong indication that tooth decay was a very serious problem in early 19th century 's-Hertogenbosch. See Table 14 for a comparison of these three values with data of other periods in the history of the Low Countries. After a long preceding period of slow rising caries frequencies, a sudden strong increase was found in the first half of the 19th century. An obvious major cause must have been the substantially increased amount of sugar in the diet at that time. At the end of the 18th century refined sugar from sugar beets became readily available for consumption (Burema, 1953; Hardwick, 1960). Easily fermentable sugars boost the growth of oral microorganisms and consequently accelerate tooth decay (caries) and eventually antemortem loss. The slow rise in dental decay preceding this sudden change was associated before with an other cause i.e., the decreasing coarseness of diet components especially of bread (Maat and Van der Velde, 1997). The resulting decrease in dental (molar) attrition left many natural pits and fissures at the occlusal plane of teeth longer open for the attack by microorganisms and their harmful metabolites. With respect to this latter cause, and in contrast to other periods, the first half of the 19th century did not differ in attrition from the preceding 17th and 18th centuries. As can be seen from the age-attrition diagrams of Figure 18, 19, 20 and 21, the first half of the 19th century showed no appreciable increase in molar attrition. The 's-Hertogenbosch age-attrition diagram was extracted from age-attrition data as presented in related paragraph of the 'Results'.

Degrees of alveolar atrophy (tooth socket retraction), calculus formation (tartar) and periodontitis (inflammation of the histological attachment of teeth to alveolar bone) were not alarming. All processes were slightly to moderately developed. The search for a statistically significant correlation between them produced an acceptable relationship between the presence of calculus and periodontitis. Probably this is a functional relationship, since extending calculus formation along the cemento-enamel junction will irritate the adjacent gingiva (gum) and periodontium to a state of chronic inflammation. Dental wear channels/facets, as proof of clay pipe smoking were found in great numbers (28% of the adults). Not only many males (44%), but also quite some females (12%) appeared to have smoked regularly. Up until now, female smoking was only recorded from skeletal remains of contemporary female slaves working on plantations in Suriname (1793-1861 AD; Khudabux, 1991). The frequency for males is exactly the same as found in 18th-early19th century Alkmaar (44%; Baetsen, 2001), but not very high if compared to 17-18th century whalers (86%; 3.7 channels per smoker; Maat, 1981).

Paleopathology

A bird's-eye view of all paleopathology listed in the Tables 6-10 made us decide to comment only on those pathological changes typical for the 's-Hertogenbosch collection. Nevertheless, the list and complete breakdown of diseases and anomalies is of prime interest for comparative studies.

Mechanical traumas

Most remarkable for this population of citizens was the high number of individuals with healed fractures (N=65). This is especially true, if we take into consideration that the 316 inspected skeletons were incomplete, and that spinal fractures were excluded from the count. Still 20% of the skeletons showed gross antemortem injuries. For a comparison: the frequency for also 316 citizens from late mediaeval Dordrecht was 13% (Maat et al., 1998), that for 50 Dutch whalers from the late 17-18th century 28% (Maat, 1981). The profession of the latter group was known for its occupational high risk to contract fractures. With respect to the non-spinal skeleton parts, the breakdown of Table 10 seemed to show a not unusual distribution of the involved bones for a civilian population (Figure 22). But on closer view the overall frequency for healed fractures of the forearm was very high (14-16%), much higher than for citizens in Dordrecht (3%, Maat et al., 1998) and in Leiden (1.5%, Maat et al., 1984) and even higher than for Dutch whalers (8%, Maat, 1981). In two individuals (G-18, an individual of unknown sex of 40-60 years; G-343 a male of 47-56 years, Figure 23) all fractures were situated around the elbow joint and included the humerus, ulna and radius! Were all these forearm fractures an occupational disorder? We do not know.

Also spines showed many of injuries: 6% spondylolysis (a fatigue fracture separating the vertebral arch from the vertebral body; Figure 24), 22% endplate avulsions (vertebral body dislocations due to abrupt hyperflexion-hyperextension movements of the spine; Figure 24, 25) and 5% compression fractures of complete vertebral bodies (due to unexpected axial force on the spine). However we should keep in mind that spine injuries happen much more frequently than recently thought (Maat and Mastwijk, 2000). For instance endplate avulsion frequencies in late mediaeval Gorinchem and in 17th century-1824 Breda came in the same range, 29% and 23% respectively. Apparently many so-called 'minor' traumas like falls, horse-riding accidents, etc, leave their marks in the spinal column.

Infections

Another remarkable observation was the unprecedented high number of bone changes due to non-specific hematogenous infections: 13 individuals (11%) suffered from a bilateral periostitis of their tibias (an infection of the tibial membrane; Figure 26) and 11 other individuals suffered from a serious osteomyelitis (an infection of the entire bone; Figure 27, 28, 29, 30)! Especially the bilateral presence of tibial periostitis is fine parameter of the infection pressure on a community since it is due to a symmetrical hematogenous infection of body parts. The tibia is very vulnerable to such infections since the local slow bloodstream makes it relatively easy for microorganism to settle down and colonize. Unilateral periostitis is typical for a direct infection of the membrane by a perforation through the skin of the shin. For comparison: the frequency of hematogenous (bilateral) periostitis in late mediaeval Dordrecht was 4% (Maat et al, 1998), Delft 2% (Onisto et al, 1998) and Gorinchem 5% (Maat and Mastwijk, 2000), in 17-18th century Leiden <1% (Maat et al., 1984), in 17th century-1824 Breda 4% (Maat and Mastwijk, 2000) and in 1725-1828 Alkmaar <7% (Baetsen, 2001). Most likely the causes of the relative high frequency of non-specific infections in 's-Hertogenbosch were the same as that of the many outbreaks of epidemic diseases in the same period (see above; Portegies, 1999): overcrowding, urbanization, poor hygiene and a very poor health status of the lowest social class. Only one case of a specific infection was found: tuberculosis of a 21-23 year old female (G-209). The affection had caused characteristic non-reactive defects in the vertebras of her spine.

Deficiency diseases

As expected the frequency of rickets (children 4%, adults 7%!) was relatively high in this impoverished class of the community with its deficient diet. For a comparison: in late mediaeval Dordrecht the frequency was 4% (Maat et al, 1998), in Delft 2% (Onisto et al, 1998), in 17-18th century Leiden 1-1.5% (Maat et al., 1984), in 17th century-1824 Breda 33% (why so high?; Maat and Mastwijk, 2000) and in 1725-1828 Zwolle 5% (Aten, 1992), in Alkmaar 1-2% (Baetsen, 2001). Abraham Walkart, who was physician in 's-Hertogenbosch during 1766-1795 mentioned that in his time many females had deformed pelvises from the 'English disease' (rickets; Portegies, 1999). A shortage of vitamin D is the caused by a lack of sunlight (with the help of ultraviolet light on the skin, human subcutaneous tissue can produce vitamin D itself) or by a lack of animal fat in the diet (animal fat, including that of fish, contains a lot of vitamin D). Vitamin D is needed to deposit minerals in bone tissue. A shortage causes the body weight bearing bones, especially the tibias and fibulas, to bend.

Cribra orbitalia (pitting of the orbital roof; Figure 31) and cribra femora (pitting of the antero-inferior surface of the femoral neck; Figure 32) are said to be caused by chronic anemia due to a chronic shortage of iron. The latter could be the result of a deficient diet or of frequent blood loss due to for instance menstruations in females, intestinal bleedings from parasite infections, etc (Stuart-Macadam, 1992). In response to the anemia, the activated blood producing bone marrow expands at the cost of its covering cortex making it look porous and pitted. The vault with its orbital roof and the proximal end of the femur with its neck are well-known sites of blood production both in children and adults. As seen from Table 6, the very high frequencies for children and adults seem to indicate an extremely serious nutritional situation. Unfortunately data on cribra femora are not available from literature, but data on cribra orbitalia to compare with are from late mediaeval Dordrecht 3% (Maat et al, 1998) and Delft 3% (Onisto et al, 1998), from 17th century-1824 Breda 17% non-adults, 3% adults (Maat and Mastwijk, 2000), from 1725-1828 Alkmaar 1% (Baetsen, 2001) and from 's-Hertogenbosch 16% non-adults, 6% adults (this study). The comparison shows that the latter scores are a little higher, but not that much. Like in Breda, growing non-adults had the highest score for cribra orbitalia and also for cribra femora. Of course growing individuals are the first to suffer from diet deficiencies. But the difference found in frequencies between growing non-adults (16-30%) and adults (6-23%) might at least in part be the result of the ongoing remodeling process at the external surface of bones of children. As a consequence, in child skeletons fast remodeling curved skeleton parts like that of the vault and the femoral neck usually show temporary porosity of their surface. Cribra femora should not be confused with an Allen's fossas and Poirier's facets (see below).

Tumors

Since most tumors arise from non-osseous soft tissue of the body, few examples of benign tumors (osteoma, osteochondroma / Figure 33 and osteoblastoma) and malignant tumors (multiple myeloma and metastases) were found in the collection (Table 6). Still, soft tissue originating tumors might metastase to skeleton parts. One example of unknown origin was found.

Arthropathies

Degenerative disc disease (DDD or vertebral osteophytosis/VO; Figure 34), results from the degeneration of fibro-cartilaginous tissue of the intervertebral disc with increasing age. As a result disc tissue herniates from the original disc space and may press on passing nerve roots if directed dorso-laterally (nerve root compression syndromes). But in most cases the herniation protrudes anteriorly without nerve compression. In dry bone vertebras the pathology can be recognized by so-called Schmorl's noduli (disc material impressions in vertebral endplates) and by reactive osteophytes (bony protrusions) along the rim of the vertebral body. The frequency of this common affection was high (59% of the adults; Table 7), but not unusual for a civil population. In late mediaeval Dordrecht it was 64% (Maat et al, 1998), in Delft 38-44% (Onisto et al, 1998), in Gorinchem 57% (Maat and Mastwijk, 2000), in 17th century-1824 Breda 40% (Maat and Mastwijk, 2000), in 1725-1828 Alkmaar 62% (Baetsen, 2001).

Another spine affection, 'vertebral osteoarthritis' (vOA) was also frequently seen (36%; Table 7; Figure 34). In this common disease the degenerative process affects the cartilage of the vertebral facet joints of the vertebral arches. These synovial joints are positioned between the vertebral arches, behind the vertebral bodies. As a result of osteoarthritis the joint surface may show pitting, subchondral cysts, marginal osteophytes and in severe cases eburnation (bone to bone wear). Patients complain about backache, start-up stiffness, pain and crepitus. In 's-Hertogenbosch, like in most other collections, the usual high frequency for adults (36%) was still substantially lower than that of DDD (59%, see above).

Peripheral osteoarthritis (pOA; Figure 35), which has the same pathogenesis as vertebral osteoarthritis, affects non-spinal synovial joints (shoulders, elbows, hips, knee, etc). Traditionally, osteoarthritis is attributed to wear and tear of joints from excessive use, but a strong constitutional (genetic) factor is also involved in its pathogenesis (Maat and Mastwijk, 1995). Recently the prevalence of osteoarthritis of the hip and knee joint has attracted attention, since it was noted in England by Rogers and Dieppe (1994) and Waldron (1995), and in the Netherlands in Alkmaar by Baetsen and Bruintjes (2001) that knee osteoarthritis was a 'modern' disease (Figure 36). In contrast to the hip joint osteoarthritis dominated 'old days', now knee joint osteoarthritis seems to have become more prevalent. The turning point in England was the end of the mediaeval period. The Alkmaar study suggested that the Dutch turning point was much later i.e., after the 18th century. But other studies show that there have been at least three turning points in the Netherlands, all reversing earlier trends. With respect to osteoarthritis percentages the hip/knee joint balance was not always in favor of the hip joint: 12/6 in late mediaeval Dordrecht (Maat et al, 1998), but 2.3/6.8 in 17-18th century Leiden (Maat et al., 1984), 9.2/6.4 in 1725-1828 Alkmaar (Baetsen, 2001), but 28/8 in 's-Hertogenbosch (this study) and 3.5/9.2 in 20th century Zoetermeer (Van Saase et al, 1989).

The slowly progressing disease process of DISH (diffuse idiopathic skeletal hyperostosis; Forestier's disease), ossifies ligaments and joint capsules between bones, muscle attachments on bones (tendon insertions) and cartilaginous structures with increasing age. It slowly makes the body more rigid. From literature there is strong evidence that high status and a plentiful diet are stimulating factors to develop this disease (Waldron, 1985; Rogers and Waldron, 1995, Janssen an Maat, 1999). The frequency in case of the Saint Servaas canons, who were known for their high status (see the paragraph on 'stature') and abundant diet, was 100% (Janssen and Maat, 1999). Because criteria for the diagnosis of various authors differ considerably, a comparison was only made for skeleton material inspected by the authors. The frequency in late mediaeval Dordrecht was 19% (Maat et al, 1998), in Delft 8-20% (Onisto et al, 1998), in Gorinchem 42% (Maat and Mastwijk, 2000), in 17th century-1824 Breda 20% (Maat and Mastwijk, 2000), in 1830-1858 's-Hertogenbosch only 11% (this study). Since average age at death of these populations was almost the same, producing comparable average lengths of disease periods, the relatively low percentage of DISH in 's-Hertogenbosch corroborated the documentation that the people buried in the north-eastern section of the cemetery were from the lowest social class and that their nutritional state was poor.

Frequencies of other (seronegative) arthropathies were not unusual (Table 7). Typical examples were for instance found of gout with its typical tophi (acute arthritis injuries due to crystallization of urates in peripheral joints, associated with dietary overindulgence; Figure 37) and Von Bechterew's disease (a inflammation of unknown origin causing characteristic ossifications of spinous ligaments, so-called a bamboo-spine; Figure 38).

Miscellaneous pathological changes

As expected, most frequencies in the list of miscellaneous pathological changes were low (Table 8). For reasons of instructiveness, two good examples of such pathological changes were illustrated: basilar impression and hyperostosis frontalis interna. Basilar impression is a serious and large indentation of the base of the skull by the vertebral column (Figure 39). As a result neurological symptoms may develop by the direct pressure of the spine onto the brainstem and its vascularization. In our case, a 34-38 year old individual of unknown sex, none of the diseases which might weaken the cranial base, like rickets or senile osteoporosis, could be confirmed. Hyperostosis frontalis interna, a change of which the origin is matter of debate, was seen in a 50-59 year old male (Figure 40). But typically it is seen in females of that age and older. Many possible causes were mentioned in literature: hormonal (e.g. Aufderheide and Rodriguez-Martin, 1998), neoplasma (Robbins, 1968; osteoma), healed chronic meningitis.

In contrast, many Allen's fossas and Poirier's facets were recorded An Allen's fossa is a smooth groove at the antero-superior surface of the femoral neck (Figure 41). The groove develops by pressure from the tendon of the rectus femoris muscle (one of the muscles that flex the hip joint). It has been suggested that the pressure results from frequent squatting (Mann and Murphy, 1990). But it is hard to imagine that squatting was practiced at that time on such a large scale that 32% of the 's-Hertogenbosch population showed compressions (Table 8). If squatting was a causal factor at all, then an additional one should be looked for. In 19% of the skeletons with Allen's fossas, the anterior femoral neck also showed cribra femora. A percentage close to the overall frequency for adults (23%, Table 6). Cribra femora have a more caudal position. An Allen's fossa should not be confused with a so-called Poirier's facet (Kennedy, 1989; Mann and Murphy, 1990; Figure 42). This is a lateral extension of the articular surface of the femoral head over the antero-superior part of the neck. They were seen in 7% of the skeletons. Some authors suggested that they develop from the frequent use of very (too) low seats (Kennedy, 1989).

Some skeletons showed saw cuts from routine autopsies (Table 8; Figure 43). With respect to the dating of the burials, they must have been made by Carl Gobée or by H. Rapmund (Portegies, 1999). Carl Gobée was an army surgeon in 's-Hertogenbosch in the period 1834-1842 AD. For instance in 1838 he did autopsies on two soldiers and thirteen citizens. The autopsies were used to illustrate his famous book (Gobée, 1839). H. Rapmund was from 1830 the poor relief physician of the city and from 1846 the physician of the mental asylum 'Reinier Van Arkel'. He also executed many autopsies.

Anomalies

Many anomalies were found (Figure 44, 45). Except for microcephaly and scoliosis, they had little serious clinical consequences. They illustrate human variation and flexibility in genesis. The frequency with which they were found was typical.

Microcephaly is due to congenital premature fusion of cranial sutures during growth. As a result the skull becomes too small and brain growth/expansion is hampered. Eventually, it leads to intellectual incapacity.

Scoliosis, lateral bending of the vertebral column was seen to a moderate degree in 11 (7%) of the 160 spines. Like in most clinical cases the origin stayed unknown. Rickets, a possible cause, could not be confirmed in the recorded cases. Overall, the frequency in late mediaeval Dordrecht it was 1% (Maat et al, 1998), in 1725-1828 Zwolle 10-11% (Aten, 1992), in Alkmaar 9% (Baetsen, 2001). It is hard to interpret these data since criteria differ to a great extent between authors.

Stains on bones by copper objects

Green stains from oxygenated copper objects/gifts were found in great numbers in this roman catholic cemetery of the Saint John's Cathedral. In non-adults they were found on the vault (11%), in the neck region (13%) and on pelvis (8%), but hardly ever on the hand/wrist.

Remarkably, no statistically differences were found between children younger than 5 years and older non-adults of 5-20 years of age. Most likely the stains were from hairpins, diadems (?), trinkets and rosaries. The latter object must have been a common attribute in the roman-catholic community of 's-Hertogenbosch. Rosaries were given to the deceased in their coffin.

Adult males showed far less stains on their vault if compared to females (respectively 2% and 13%). We assume that the relative high frequency in females was most likely due to hairpins and diadems (?).

Both in adult males and females, high but statistically not different frequencies of stains were found in the neck region (respectively 8% and 10%), on the pelvis (respectively 21% and 31%) and on the cluster 'pelvis plus hand/wrist' (respectively 26% and 34%). Probably as a consequence of the typical Christian way of interring i.e., with the arms extended along the body or the hands folded in the lap as for praying, rosaries had stained the surrounding bones. With respect to this custom there seemed to be a difference between individuals younger than 20 years and adults, as the cluster 'pelvis plus hand/wrist' frequencies were statistically different (respectively 9% and 29%).

CONCLUSION

In general, the physical anthropological evidence observed on the 316 skeletons recovered from the north-eastern section of the 'Sint Janskerkhof' (1830-1858 AD) corresponded well with existing documentation. A distinct cluster of burials of premature and small children, suggesting a separate area of non-consecrated ground, was found in the transition area between archaeological pit number III and IV of the cemetery. By comparing the investigation results of this large sample with those of other skeleton collections from various periods of other Dutch cities, the expected poor nutritional and health performance of this lower social class section of the city population was confirmed. Of the deceased 30% was less than 20 years old. The average age at death of the adults over 20 years of age was 42 years. The average stature of males was low (169.6 cm). Dental health was poor. The caries frequency was 21% of the inspected teeth. Many, bone changes were found from mechanical traumas (at least in 20% of the skeletons), non-specific hematogenous infections (11% of the inspected) and deficiency diseases (7% of the adults had suffered from rickets). The frequency of Diffuse Idiopathic Skeletal Hyperostosis, the disease of the 'well-off' was only 11%. Copper stains on the skeletons reflected different patterns of distributions of interred objects/gifts between males and females, and between non-adults and adults.

ACKNOWLEDGEMENTS

We would like to express our cordial thanks to the Municipality of the city of s'-Hertogenbosch and especially to the city archaeologists H.L. Janssen, D.M. Van de Vrie, to Ms. F.C. Schipper (cartographer), to J.C. Galligan (corrector of the English manuscript) and to laboratory photographer Jan Lens of the Department of Anatomy, Leiden University Medical Center.

REFERENCES

Acsádi, G. and Nemeskéri, J. History of human life span and mortality. Hungarian Academic Society, Budapest, 1970.

Arcini, C. Health and disease in early Lund. Thesis. Archaeologica Lundensia. Investigationes de antiquitatibus urbis Lundae 8, Medical Faculty Lund University, Lund, 1999.

Aten, N. 'Het onderzoek van de skeletten. De geslachtsdiagnose en de leeftijdsdiagnose'. In: 'De doden vertellen. Opgraving in de Broerenkerk te Zwolle 1987-1988 (Clevis, H. and Constandse-Westermann, T., eds.). Stichting Archeologie IJssel/Vechtstreek, 67-97, 1992.

Aufderheide, A.C. and Rodriguez-Martin, C. The Cambridge encyclopedia of human paleopathology. Cambridge University Press, Cambridge, 1998.

Baetsen, S. 'Graven in de Grote Kerk'. 'Rapporten over de Alkmaarse Monumentenzorg en Archeologie' Nr. 8, with an English summary (Baetsen, S. and Bitter, P.). Municipality of the city of Alkmaar, 2001.

Baetsen, S. and Bruintjes, Tj. D. Hip and knee osteoarthritis in an eighteen century urban population. In: 'Graven in de Grote Kerk'. 'Rapporten over de Alkmaarse Monumentenzorg en Archeologie' Nr. 8 (Baetsen, S., ed.). Municipality of the city of Alkmaar, 85-87, 2001.

Beer, H. de. Nutrition, health and labour in the Netherlands during the nineteenth century. A contribution to anthropometric history. Thesis, Utrecht, AKSANT, 2001.

Boas, F. Changes in the bodily form of descendants of immigrants. American Journal of Physical Anthropology N.S., 14: 530-562, 1912.

Bouts, W.H.M. 'Skelettenverslag St. Jan'. Excavation report, 1-11, 1984.

Bouts, W.H.M., Constandse-Westermann, T., Pot, Tj. and Verhoeven, H. 'Gebitsresten uit de Broerenkerk, Zwolle, circa 1800 AD. Wijze van onderzoek en resultaten. In: 'De doden vertellen. Opgraving in de Broerenkerk te Zwolle 1987-1988 (Clevis, H. and Constandse-Westermann, T., eds.). Stichting Archeologie IJssel/Vechtstreek, 99-141, 1992.

Breitinger, E. Zur Berechnung der Körperhöhe aus den langen Gliedmassenknochen. Anthropologische Anzeiger 14: 249-274, 1937.

Brothwell, D.R. Digging up bones. 3rd ed. British Museum. Oxford University Press, Oxford, 1981.

Burema, L. De voeding in Nederland van de middeleeuwen tot de twintigste eeuw. Van Gorkum, Assen, 1953.

Clevis, H. and Constandse-Westermann, T (eds.). 'De doden vertellen. Opgraving in de Broerenkerk te Zwolle 1987-1988. Stichting Archeologie IJssel/Vechtstreek, 1992.

Fredriks, A.M., Buuren, S. Van, Burgmeijer, R.J.F., Meulmeester, J.F., Beuker, R.J. Brugman, E., Roede, M.J., Verloove-Vanhorick, S.P., Wit, J-M. Continuing positive secular growth change in the Netherlands 1955-1997. Pediatric Research 47: 316-323, 2000.

Gobée, C. 'Klinische bijdragen tot de theorie en praktijk der genees- en heelkunde. Utrecht, 1839.

Hardwick, J.L. The incidence and distribution of caries throughout the ages in relation to the Englishmen's diet. British Dental Journal 108: 9-17, 1960.

Janssen, H.L. 'Inleiding: Het specialistisch onderzoek in het kader van het uitwerkingsbeleid in 's-Hertogenbosch'. In: 'Kroniek bouwhistorisch en archeologisch onderzoek 's Hertogenbosch', part I (Boekwijt, H.W. and Janssen, H.L., eds.). Kring Vrienden van 's-Hertogenbosch, 's-Hertogenbosch, 68-74, 1988.

Janssen, H.L. and Van de Vrie, D.M. Personal communications. Municipal Archaeological Service s'-Hertogenbosch, 2001.

Janssen, H.A.M. and Maat, G.J.R. Canons buried in the "Stiftskapel" of the Saint Servaas Basilica at Maastricht, 1070-1521 AD. A paleopathological study. Leiden, Barge's Anthropologica 5: 1-40, 1999.

Kennedy, K.A.R. Skeletal markers of occupational stress. In: Reconstruction of life from the skeleton (Iscan, M.Y. and Kennedy, K.A.R., eds.). Alan R. Liss, New York, 1989.

Khudabux, M.R. Effects of life conditions on the health of a Negro community in Suriname. With reference to similar aspects in local pre-Columbian Amerindians. Thesis, Leiden University, Leiden, 1991.

Knussmann, R. Anthropologie. G. Fischer, Stuttgart, New York, 1988.

Lonnée, H.A. and Maat, G.J.R. Inhumations in a Roman cemetery at Valkenburg-Marktveld (Zuid-Holland) in The Netherlands. Leiden, Barge's Anthropologica 3: 1-50, 1998.

Maat, G.J.R. Human remains from Dutch whaling stations on Spitsbergen. A physical anthropological study. In: Early European Exploitation of the Northern Atlantic 800-1700 (Van Holk, A.G.F., s'Jacob, H.K. and Temmingh, A.A.H.J., eds.). Groningen, Arctic Centre, 153-201, 1981.

Maat, G.J.R. A search for secular growth changes in The Netherlands preceding 1850. In: Human Growth and Development. Borms, J., Hauspie, R., Sand, A., Susanne, C., Hebbelinck, M. (eds.). New York, Plenum Press, 185-191, 1984.

Maat, G.J.R., Haneveld, G.T., Brink, M.R.M. Van den, and Mulder, W.J. A quantitative study on pathological changes in human bones from the 17th and 18th centuries excavated in the "Hoogland Church", Leiden. In: Proceedings Paleopathology Association, 4th European Meeting Middelburg/Antwerpen, 1982 (Haneveld, G.T., Perizonius, W.R.K. and Janssens, P.J., eds.). Utrecht, Paleopathology Association, 82-93, 1984.

Maat, G.J.R. and Van der Velde, E.A. The caries attrition competition. International Journal of Anthropology 2:281-92, 1987.

Maat, G.J.R. Growth changes in bones. A means of assessing health status and the relative position of secular growth shift in stature. In: E. Iregren and R. Liljekvist (eds.). Populations of the Nordic Countries. Human population biology from the present to the Mesolithic. Lund, Institute of Archaeology Report Series 46: 88-93, 1993.

Maat, G.J.R., Mastwijk, R.W. and Van der Velde, E.A. Skeletal distribution of degenerative changes in vertebral osteophytosis, vertebral osteoarthritis and DISH. International Journal of Osteoarchaeology 5: 289-298, 1995.

Maat, G.J.R., Mastwijk, R.W. and Van der Velde, E.A. On the reliability of non-metrical morphological sex determination of the skull compared with that of the pelvis in The Low Countries. International Journal of Osteoarchaeology 7: 575-580, 1997.

Maat, G.J.R., Mastwijk R.W. and Sarfatij, H. A physical anthropological study of burials from the graveyard of the Franciscan Friary at Dordrecht, circa 1275-1572. 'Rapportage Archeologische Monumentenzorg' 67. State Archaeological Service (ROB), Amersfoort, 1998.

Maat, G.J.R., Panhuysen, R.G.A.M. and R.W. Mastwijk. Manual for the Physical Anthropological Report. Leiden, Barge's Anthropologica 6: 1-50, 1999.

Maat, G.J.R. and Mastwijk, R.W. Avulsion injuries of vertebral endplates. International Journal of Osteoarchaeology 10: 142-152, 2000.

Maat, G.J.R. Diet and age at death determinations from molar attrition. A review related to the Low Countries. Journal of Forensic Odonto-Stomatology 19: 18-21, 2001.

Maat, G.J.R. Physical Anthropological Records of the Leiden Cadaveric Collection. Males born 1880-1932 AD and had died 1947-1970 AD. N=100. Department of Anatomy, Leiden University Medical Center.

MacLaughlin, S.M. and Bruce, M.F. A simple univariate technique for determining sex from fragmentary femora: its application to a Scottish short cyst population. American Journal of Physical Anthropology 67: 413-417, 1985.

Mann, R.W. and Murphy, S.P. Regional atlas of bone disease. A guide to pathologic and normal variation in the human skeleton. Ch.C. Thomas, Springfield, 1990.

Mays, S. The archaeology of human bones. Routledge, London, 1998.

Martin, R. and Saller, K. Lehrbuch der Anthropolgie. Band I. Fischer Verlag, Stuttgart, 1957.

Mommers, A.R.M. De gezondheidstoestand te 's-Hertogenbosch. Na de verovering door de Fransen in october 1794. Brabantia 4: 73-80, 1955.

Onisto, N., Maat, G.J.R. and Bult, E.J.. Human remains from the infirmary "Oude en Nieuwe gasthuis" of the City of Delft in The Netherlands 1265-1652 AD. Leiden, Barge's Anthropologica 2: 1-43, 1998.

Oppers, V.M. The secular trend in growth and maturation in the Netherlands. Tijdschrift voor Geneeskunde 44: 539-548, 1966.

Ortner, D.J. and Putschar, W.G.J. Identification of pathological conditions in human skeletal remains. Smithsonian Institution Press, Contribution Nr. 28, Washington, 1985.

Rogers, J. and Waldron, T. A field guide to joint disease in archaeology. Chichester, New York: Wiley, 1995.

Rogers, J. and Waldron, T. A field guide to joint disease in archaeology. Chichester, New York: Wiley, 1995.

Pearson, K. IV Mathematical contributions to the theory of evolution. V On the reconstruction of stature of prehistoric races. Philosophical Transactions of the Royal Society, London. Series A, 192: 169-244, 1899.

Portegies, M. 'Dood en begraven in 's-Hertogenbosch. Het Sint-Janskerkhof 1629-1858'. Matrijs, 1999.

Robbins, S.L. Pathology. Saunders, Philadelphia, 1968.

Roede, M.J., Wieringen, J.C. Van, Growth diagrams 1980: Netherlands third nation-wide survey. Tijdschrift voor sociale Gezondheidszorg 63 (suppl.): 1-34, 1985.

Rogers, J. and Dieppe, P. Is tibiofemoral osteoarthritis in the knee joint a new disease? Annals of Rheumatic Diseases 53: 612-613, 1994.

Rogers, J. and Waldron, T. A field guide to joint disease in archaeology. Wiley and Sons, Chichester, 1995.

Pot, Tj. 'Een gebitsonderzoek van het 18de eeuwse grafveld St. Janskerkhof 1984'. In: 'Kroniek bouwhistorisch en archeologisch onderzoek 's Hertogenbosch', part I (Boekwijt, H.W. and Janssen, H.L., eds.). Kring Vrienden van 's-Hertogenbosch, 's-Hertogenbosch, 125-149, 1988.

Saase, J.L.C.M. Van, Romunde, L.K.J. Van, Cats, A., Vandenbroucke, J.P. and Valkenburg, H. Epidemiology of osteoarthritis: the Zoetermeer survey. Comparison of radiological osteoarthritis in a Dutch population with that in 10 other populations. Annals of Rheumatic Diseases 48: 271-280, 1989.

Steinbock, R.T. Paleopathological Diagnosis and Interpretation. C. Thomas, Springfield, 1976.

Stuart-Macadam, P. Porotic hyperostosis: a new perspective. American Journal of Physical Anthropology 87: 39-47, 1992.

Trotter, M. and Gleser, G.C. Estimation of stature from the long bones of American whites and Negroes. American Journal of Physical Anthropology NS 10: 463-514, 1952.

Trotter, M. and Gleser, G.C. A re-evaluation of estimation of stature based on measurements of stature taken during life and of long bones after death. American Journal of Physical Anthropology NS 16: 79-123, 1958.

Trotter, M. Estimation of stature from intact limb bones. In: Personal identification in mass disasters (Stewart, T.D., ed.). National Museum of Natural History, Washington, 1970.

Ubelaker, D.H. Human skeletal remains. Excavation, analysis, interpretation. Taraxacum, Washington, 1978.

Waldron, T. DISH at Merton Priory: evidence for a 'new' occupational disease? British Medical Journal 291: 1762-1763, 1985.

Waldron, T. Counting the dead. The epidemiology of skeletal populations. Chichester, New York: Wiley, 1994.

Waldron, T. Changes in the distribution of OA over historical time. International Journal of Osteoarchaeology 5: 385-389, 1995.

Walkart, A. Zaakelijk bericht over de natuurlijke gesteldheid der hoofdstad 's-Hertogenbosch, en de ziekten die 'er in het jaar 1779 zyn voorgevallen'. In: Verhandelingen van de Natuur- en Geneeskundige Correspondentie - Sociëteit in de Vereenigde Nederlanden. 's Gravenhage, 1783.

Wieringen, J.C. Van, Wafelbakker, F., Verbrugge, H.P., Haas, J.H. de. Growth diagrams 1965 Netherlands. Wolters Noordhoff, Groningen, 1971.

Wieringen, J.C. Van, Secular growth changes. In Human Growth III (Falkner, F. and Tanner, J.M., eds.). New York, Plenum Press, 307-331, 1986.

Wijn, J.F. de and Haas, J.H. Groeidiagrammen 1-25 jarigen in Nederland. Verhandelingen Nederlands Instituut voor Preventieve Geneeskunde XLIX, 1-29, 1960.

Wurm, H. und Leimeister, H. About recommendability and comparability of statements for estimating stature from skeletal remains and about general problems in estimating stature. Gegenbauers morphologisches Jahrbuch 132: 69-110, 1986.

Wurm, H. Ein Beitrag zu einer 'Anthropo-Historie'. Zu ernährungskonstitutionellen Verknüpfungen innerhalb der deutchen Geschichte. Das Weisermerkmal 'historische Körperhöhe'. Zeitschrift für Geschichtswissenschaft 40: 7-22, 1992.

LEGENDS

Fig. 1: Bird's-eye view showing the 'Sint Janscathedraal' (Saint John's cathedral) and the 'Sint Janskerkhof' (Saint John's cemetery). The barracks are positioned on the north-eastern sector of the cemetery (arrow). They cover the future site of excavation. From Portegies, 1999.

Fig. 2: Map showing the cathedral with cemetery. The north-eastern sector of the cemetery is indicated with a 3. From Portegies, 1999.

Fig. 3: Map showing the form and position of the excavated area (shaded). Stars indicate the sites where child skeletons were found during the excavation process. From Portegies, 1999.

Fig. 4: Map of the numbered graves in the cemetery. I-VII = archaeological pit number. Grey = sex unknown, blue = male, red = female, green = non-adults of 5.0-19.9 years of age, yellow = premature and small children of 0.0-4.9 years of age. Note that the latter form a cluster in the transition area between pit III and IV. Missing grave numbers if compared to Table 2, regard burials of unknown location in the cemetery. Map: Municipal Archaeological Service of the city of s'-Hertogenbosch

Fig. 5: Individual scores for the average antero-posterior diameter of femurs (APD). Sex class 1 = males, 2 = females, 3 = individuals which could not be sexed by means of pelvis and/or cranium. Note that only one individual from class 3 fell into the male range of scores.

Fig. 6: Individual scores for the average maximum antero-posterior diameter of femurs (APD-max). Sex class 1 = males, 2 = females, 3 = individuals which could not be sexed by means of pelvis and/or cranium. Note that only one individual from class 3 fell into the male range of scores.

Fig. 7: Individual scores for the average antero-posterior diameter of tibias (TIB). Sex class 1 = males, 2 = females, 3 = individuals which could not be sexed by means of pelvis and/or cranium. Note that only one individual from class 3 fell into the male range of scores.

Fig. 8: Individual scores for the average maximum antero-posterior diameter of tibias (TIB-max). Sex class 1 = males, 2 = females, 3 = individuals which could not be sexed by means of pelvis and/or cranium. Note that only one individual from class 3 fell into the male range of scores.

Fig. 9: Overall age at death distribution in 10-year age intervals. N= 229. Note the seven premature deceased.

Fig.10: Age at death distribution of males, teenagers of known sex included, in 10-year age intervals. N= 90.

Fig.11: Age at death distribution of females, teenagers of known sex included, in 10-year age intervals. N=78. Note the high death rate in the 20-29 years interval.

Fig.12: Age at death distribution of children, teenagers of unknown sex included, in 5-year age intervals. N= 57. Note the seven premature deaths and the high death rate in the 0.0-4.9 years interval.

Fig.13: Degree of attrition of M1 (mean value of maxillary and mandibular molars) versus age of 56 individuals together with the related regression line.

Fig.14: Degree of attrition of M2 (mean value of maxillary and mandibular molars) versus age of 60 individuals together with the related regression line.

Fig.15: Degree of attrition of M3 (mean value of maxillary and mandibular molars) versus age of 50 individuals together with the related regression line.

Fig.16: A tentative representation of stature development of adult males in the Netherlands from 0 to 1997 AD. For details see the text and Table 12.

Fig.17: Maximum femoral length development of adult males in the Netherlands from 0 to 1970 AD. For details see the text and Table 13.

Fig.18: Age-attrition diagram for the Premediaeval Period. Redrawn after Brothwell (1981).

Fig.19: Age-attrition diagram for period 1275-1572 AD after Maat (2000).

Fig.20: Age-attrition diagram for the period 1650-1800 AD after Maat (2000).

Fig.21: Age-attrition diagram for the period 1830-1858 AD. This study.

Fig.22: Healed fracture of a rib of a 51-56 years old male (G-307). The post-mortem break through the healed but porous callus formation callus was repaired.

Fig.23: Healed Pott's fracture of the distal part of the left fibula due to an external rotation injury of the ankle (upper left); and a comminuted fracture of the right elbow (supracondylar fracture of the humerus, olecranon fracture of the ulna and fracture of the radial head, followed by ankylosis and humero-radial pseudoarthrosis) of a 47-56 years old man (G-343).

Fig.24: Avulsion injury of vertebra Th 12 with 'elevation' of the crushed annular epiphysis of the inferior endplate (left), and a unilateral spondylolysis of the left half of the vertebral arch of L5 (right; the broken part is missing) of a 46-52 years old male (G-341).

Fig.25: Avulsion fracture of the antero-superior corner of vertebra Th 3 (upper left; G-168; male, 36-42 years old), of Th 5 (upper right; G-187; female, unknown age), of Th9 (lower left; G-250; female, 48-56 years of age) and of Th8 (lower right; G-403; female, 40-80 years of age).

Fig.26: Periostitis of the right tibia of a 51-57 years old male (G-345). Note the pitted surface of the midshaft.

Fig.27: Osteomyelitis, an infection of the entire bone, of both tibias and fibulas of a female of 35-55 years of age (G-219).

Fig.28: Garré's sclerosing osteomyelitis of the femurs of a 46-52 years old male (G-95). Note the distension of the proximal part of the femoral shafts. During life these distensions were situated between the flexor and adductor muscle compartments.

Fig.29: Detail of Figure 28. The shaft has been longitudinally cut open. Note the density of the reactive bone formation.

Fig.30: Vertebras Th 9-12 of the same individual of Figure 28. Note the notches in the vertebral bodies due to pressure atrophy from the expanding lymphnodes involved in the drainage of the related osteomyelitis.

Fig.31: Cribra orbitalia. Pitting of the right orbital roof due to bone marrow expansion from hyperplasia of blood producing tissue (G-195; assemblages of commingled bones).

Fig.32: Various degrees of cribra femora in the neck of the left femurs of 15-18 years old child (G-192), a 21-22 years old male (G-189) and a 63-69 years old female (G-358). The pitting is said to be the result of bone marrow expansion from hyperplasia of blood producing tissue. The most right femur has an Allen's fossa (antero-superior; compare with Figure 41) in addition to its cribra femora (antero-inferior).

Fig.33: Osteochondroma / solitary exostosis near the proximal epiphysis of the left tibia of a 66-72 year old female (G232). This benign tumor develops from proliferation and subsequent ossification of a left behind remainder of the epiphyseal disc.

Fig.34: Degenerative disc disease (DDD) and vertebral osteoarthritis (vOA) of the vertebras C1-4 of the cervical spine of a man (G-225). Note the marginal osteophytes at the vertebral endplates (DDD, arrow at right side) and along the synovial facet joints (vOA, arrow at left side).

Fig.35: Peripheral osteoarthritis. Heberden's nodes, marginal osteophytes, at the distal interphalangeal joint of the finger of a 30-36 years old female (arrow, G-13).

Fig.36: Peripheral osteoarthritis. Porosity of the joint surface, marginal osteophytes along the edges and eburnation (shiny bone to bone wear) at the femoral part of the left knee joint (G-181; assemblages of commingled bones).

Fig.37: Gout with its typical tophi in a hand. The bone lesions, due to crystallization of urates at peripheral joints, are seen at the proximal joints of two phalanges and the distal joint of metacarpal I (G-302; a 60-70 years old female).

Fig.38: Bamboo spine (thoracic part) from Von Bechterew's disease in 63-69 years old female (G-358). A remarkable case, since the disease is virtually limited to males in a 9:1 ratio.

Fig.39: Basilar impression, an impression of the cranial base by the cervical spine (G-286; 34-38 years old, sex unknown). The separate atlas has been put into position.

Fig.40: View into the cranial cavity of a (G-174) 50-59 year old male with hyperostosis frontalis interna. The frontal bone shows lumpy bone appositions on the internal table.

Fig.41: Two right femurs with an Allen's fossa. They are situated on the antero-superior part of the femoral neck, just behind the caput femoris. As can be seen, their extension may vary.

Fig.42: Poirier's facet, a lateral extension of the articular surface of the femoral head over the antero-superior part of the neck

Fig.43: Skull cap detachment due to an early 19th century autopsy from an assemblages of commingled bones of the cemetery. Note the horizontal cuts by the saw.

Fig.44: Spina bifida occulta, open vertebral arch of the atlas of a 51-56 years old male (G-307).

Fig.45: Unilateral sacralization of vertebra L5 of a male of 21-24 years old (G-285.2).

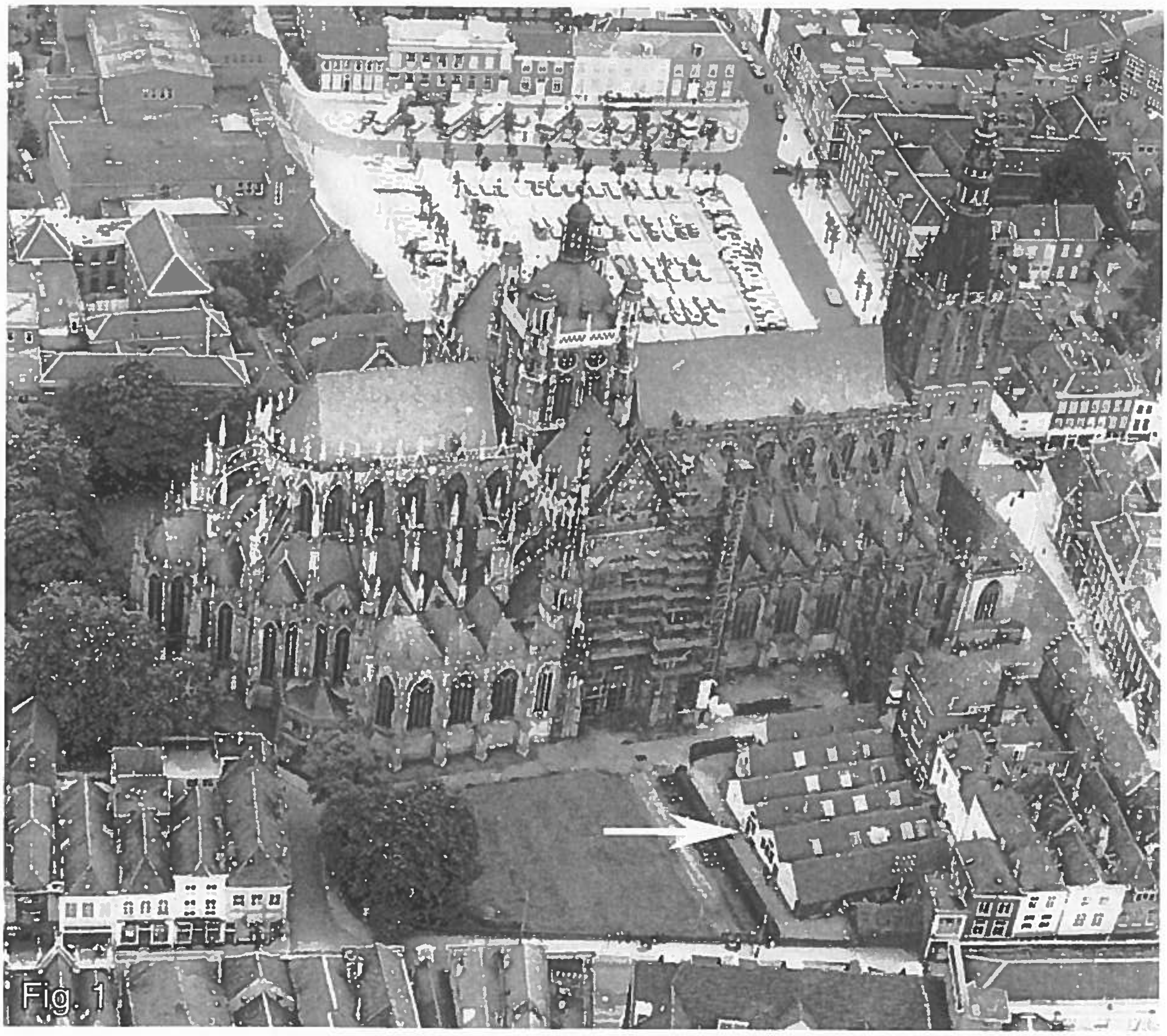
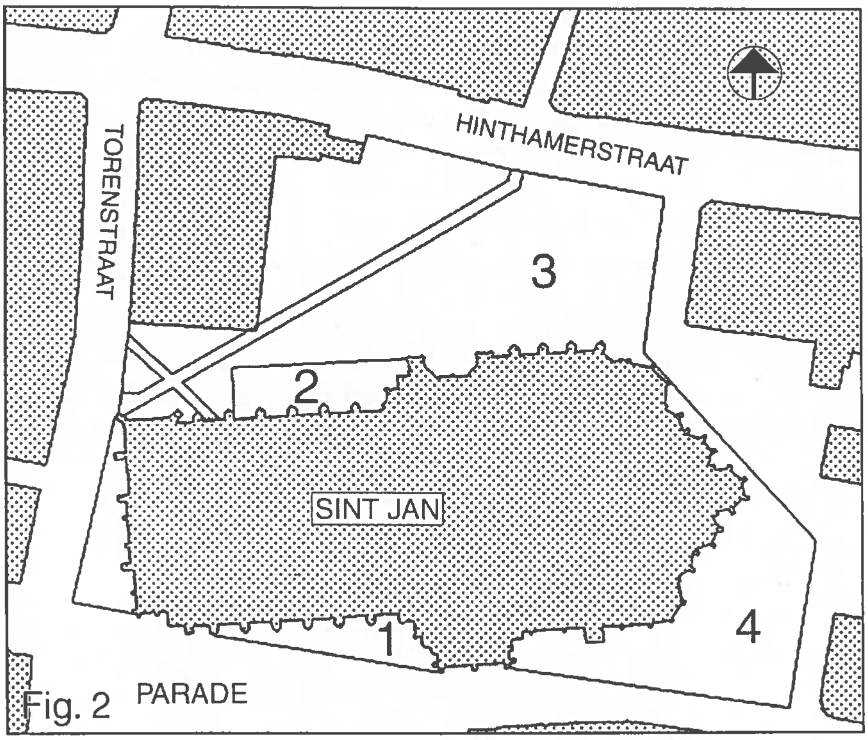
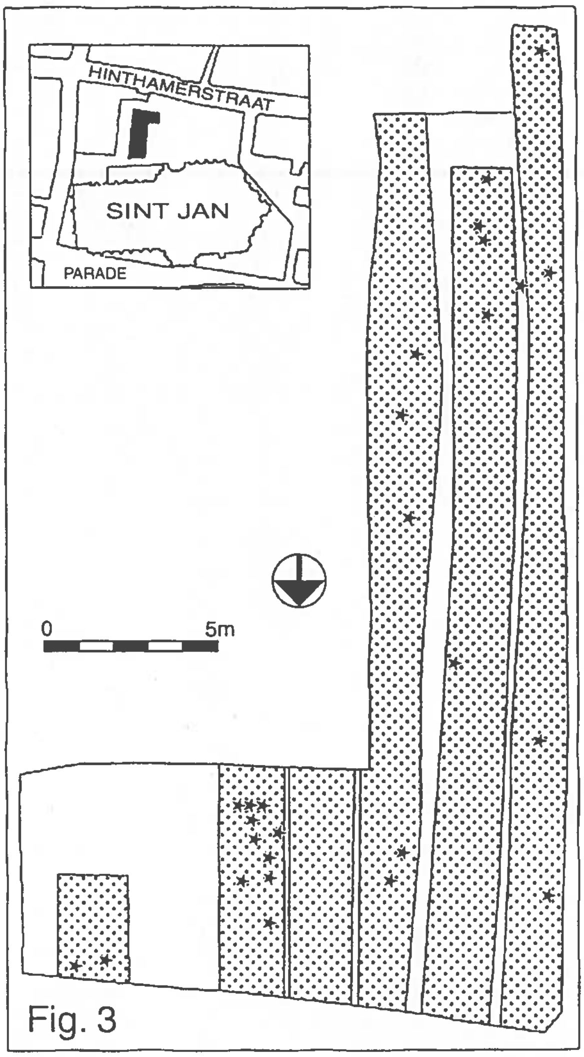


Fig. 1


HINTHAMERSTRAAT
TORENSTRAAT
3
2
SINT JAN
1
4
Fig. 2
PARADE


HINTHAMERSTRAAT
SINT JAN
PARADE
0
5m
Fig. 3

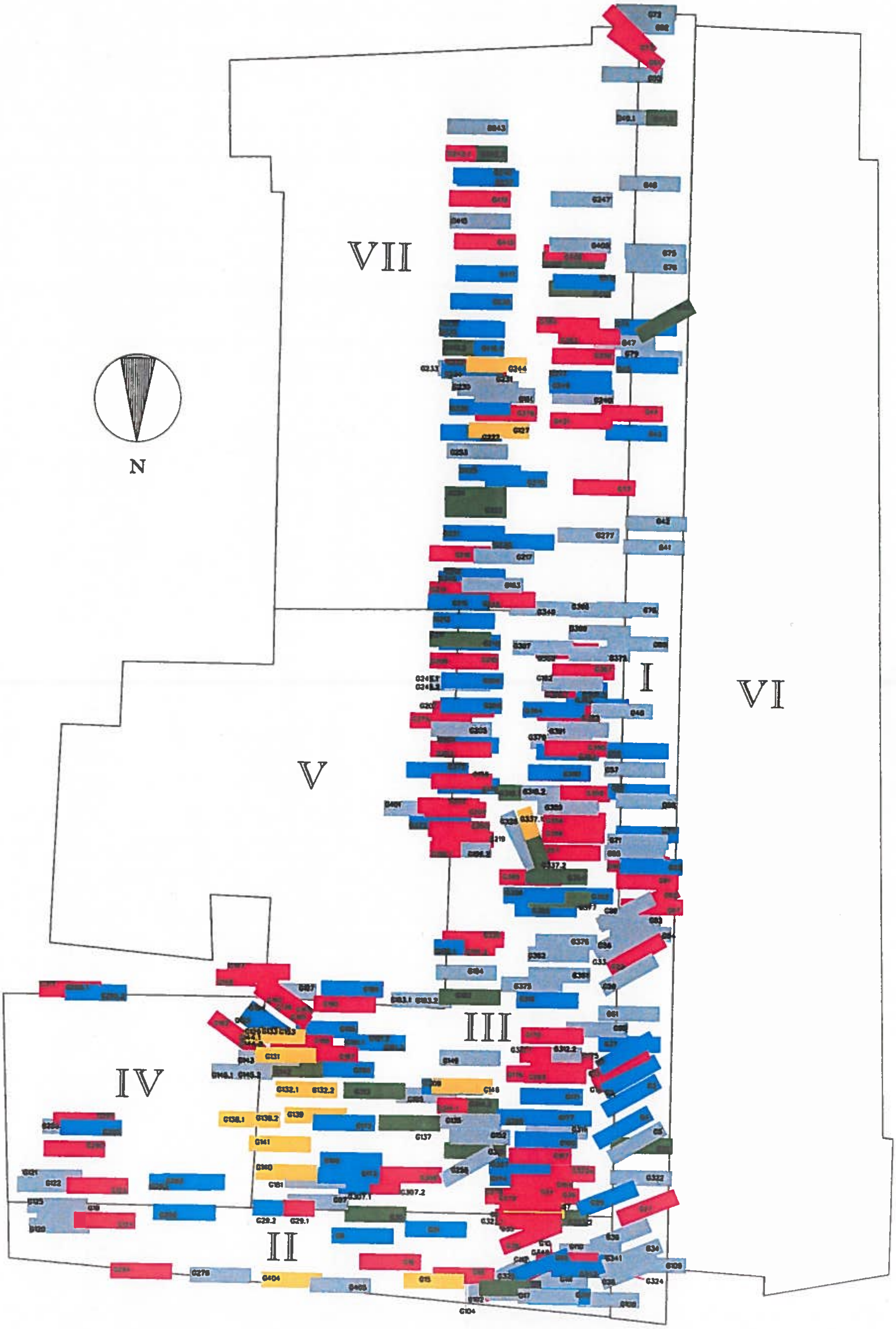


Fig. 4

'SINT JANSKERKHOF' of 's-HERTOGENBOSCH
1830-1858 AD, 79 males and 71 females

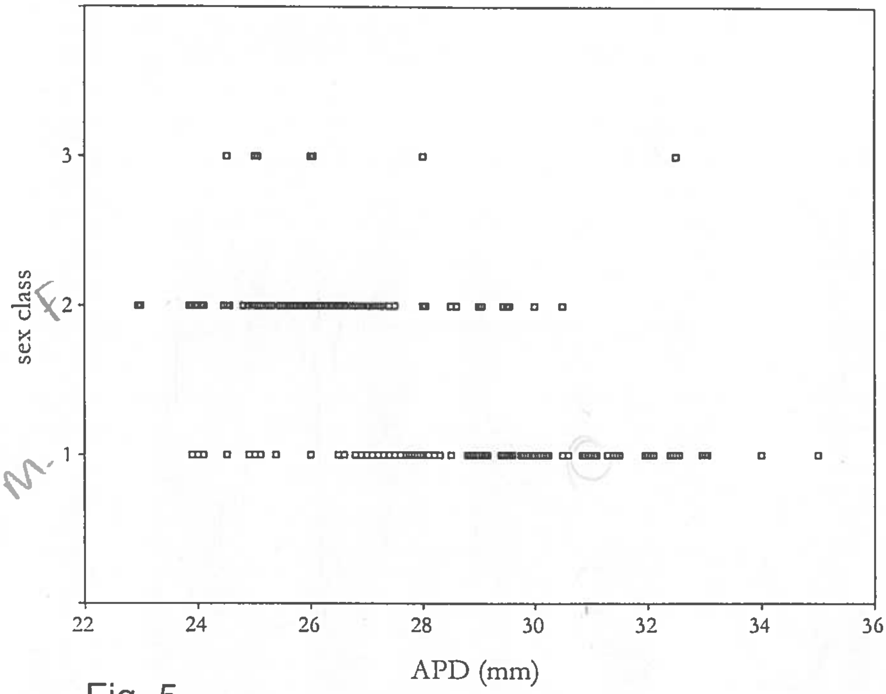


Fig. 5

'SINT JANSKERKHOF' of 's-HERTOGENBOSCH
1830-1858 AD, 67 males and 56 females

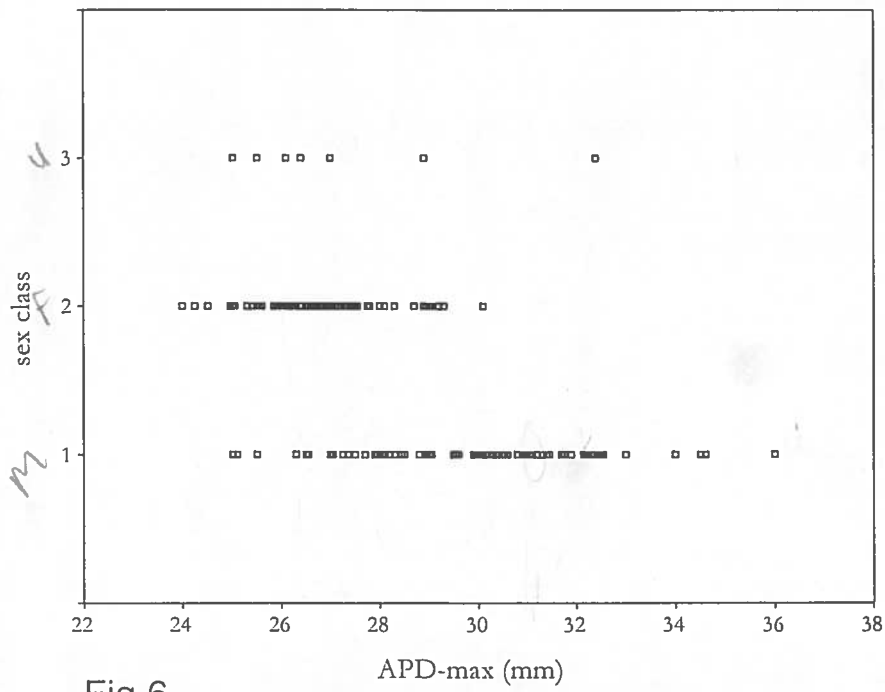


Fig.6

'SINT JANSKERKHOF' of 's-HERTOGENBOSCH
1830-1858 AD, 47 males and 34 females

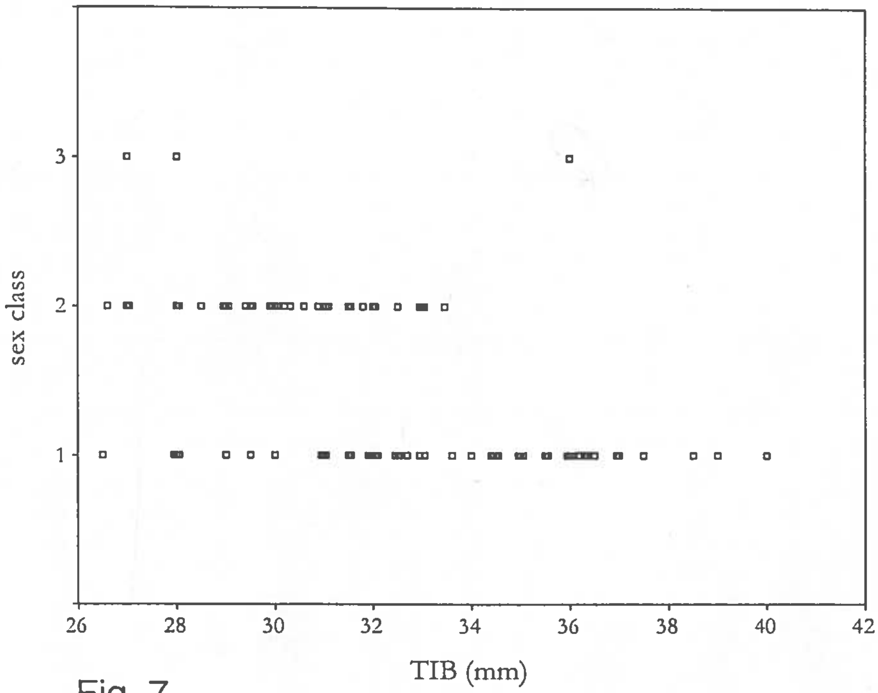


Fig. 7

'SINT JANSKERKHOF' of 's-HERTOGENBOSCH
1830-1858 AD, 42 males and 28 females

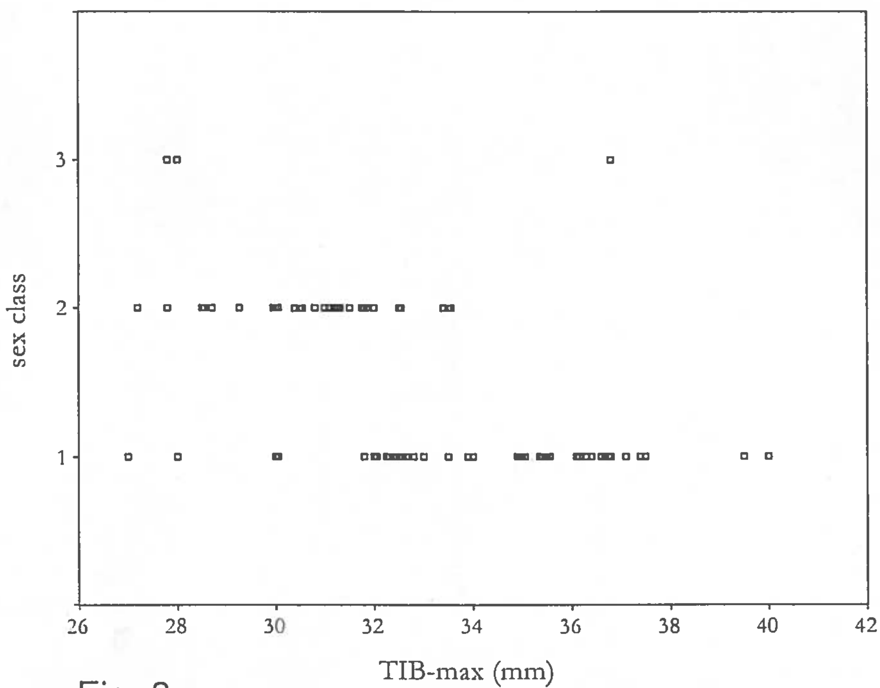


Fig. 8

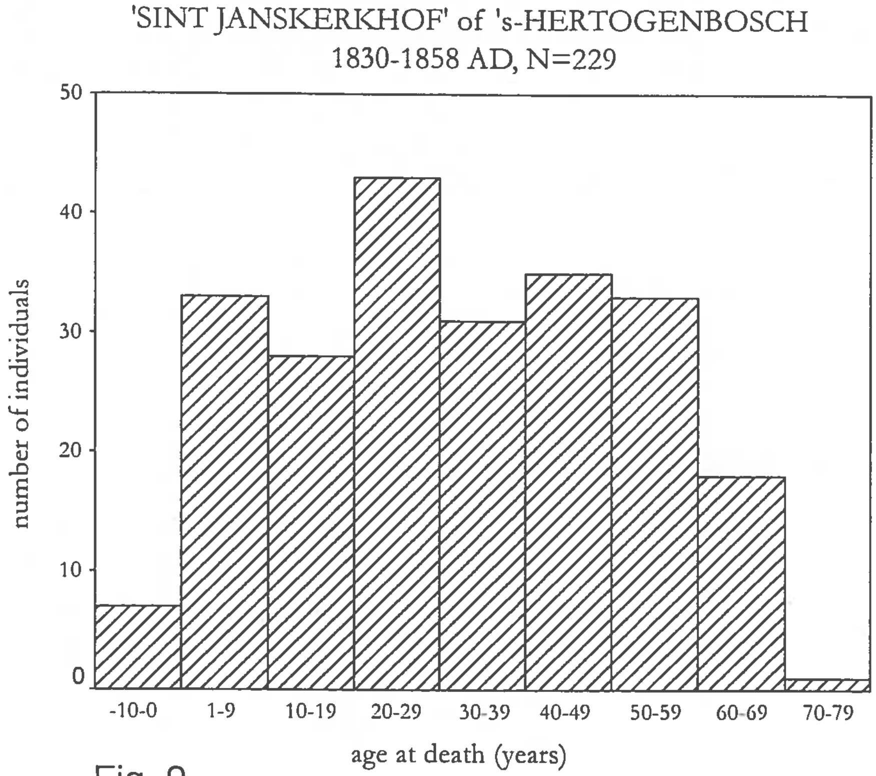

'SINT JANSKERKHOF' of 's-HERTOGENBOSCH
1830-1858 AD, N=229
number of individuals
0
10
20
30
40
50
-10-0
1-9
10-19
20-29
30-39
40-49
50-59
60-69
70-79
age at death (years)

Fig. 9

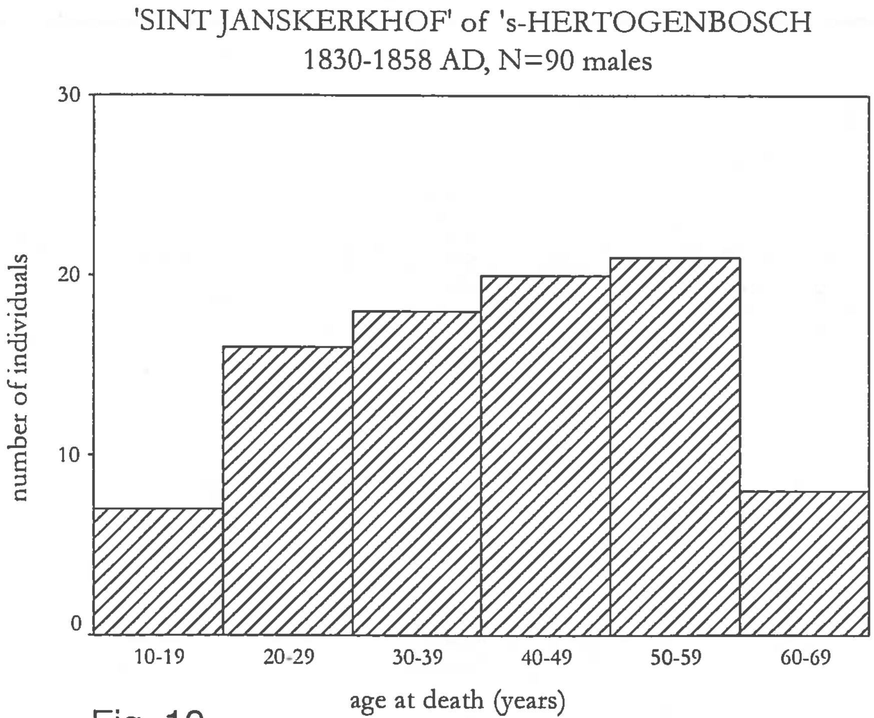

'SINT JANSKERKHOF' of 's-HERTOGENBOSCH
1830-1858 AD, N=90 males
number of individuals
0
10
20
30
10-19
20-29
30-39
40-49
50-59
60-69
age at death (years)

Fig. 10

'SINT JANSKERKHOF' of 's-HERTOGENBOSCH
1830-1858 AD, N=78 females

Fig. 11

'SINT JANSKERKHOF' of 's-HERTOGENBOSCH
1830-1858 AD, N=57 non-adults

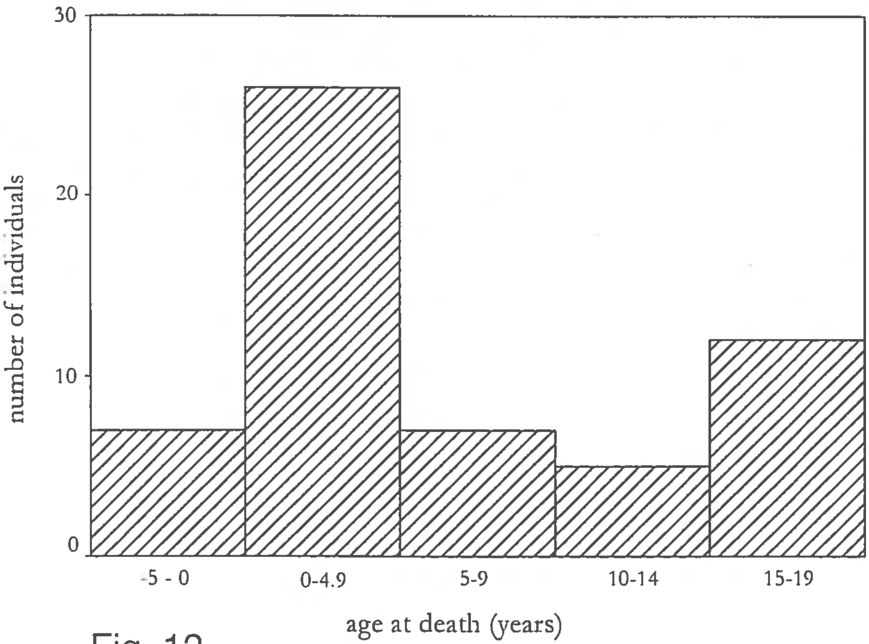


Fig. 12

'SINT JANSKERKHOF' of 's-HERTOGENBOSCH
1830-1858 AD

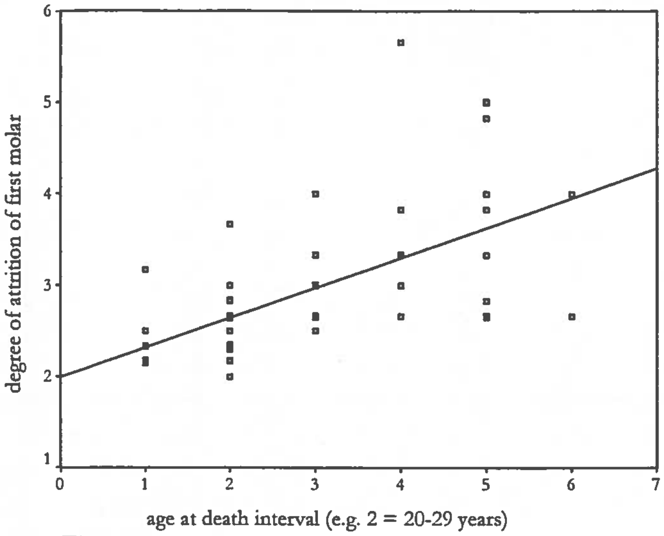


Fig. 13

'SINT JANSKERKHOF' of 's-HERTOGENBOSCH
1830-1858 AD

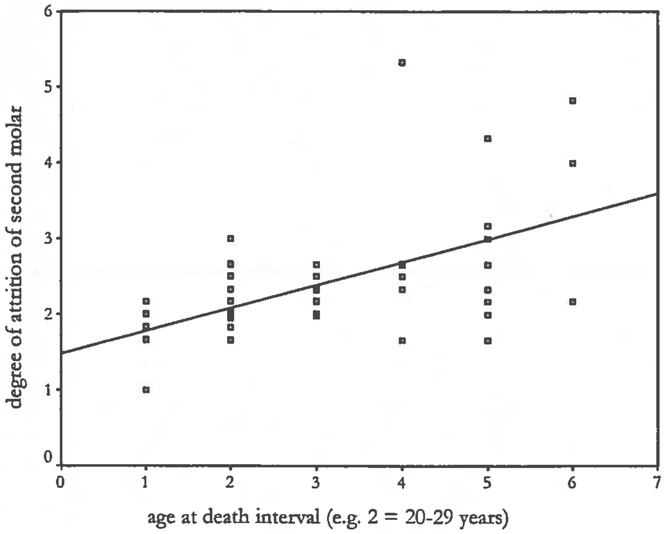


Fig. 14

'SINT JANSKERKHOF' of 's-HERTOGENBOSCH
1830-1858 AD

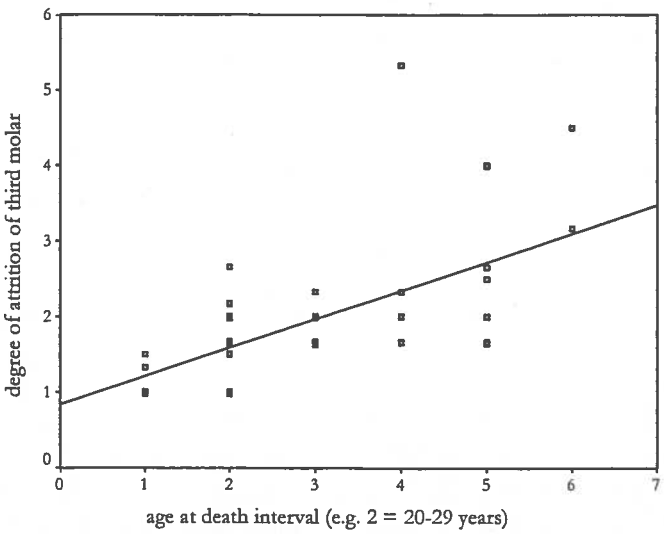


Fig. 15

STATURE Of ADULT MALES IN THE NETHERLANDS, 0 - 1997 AD
A tentative representation

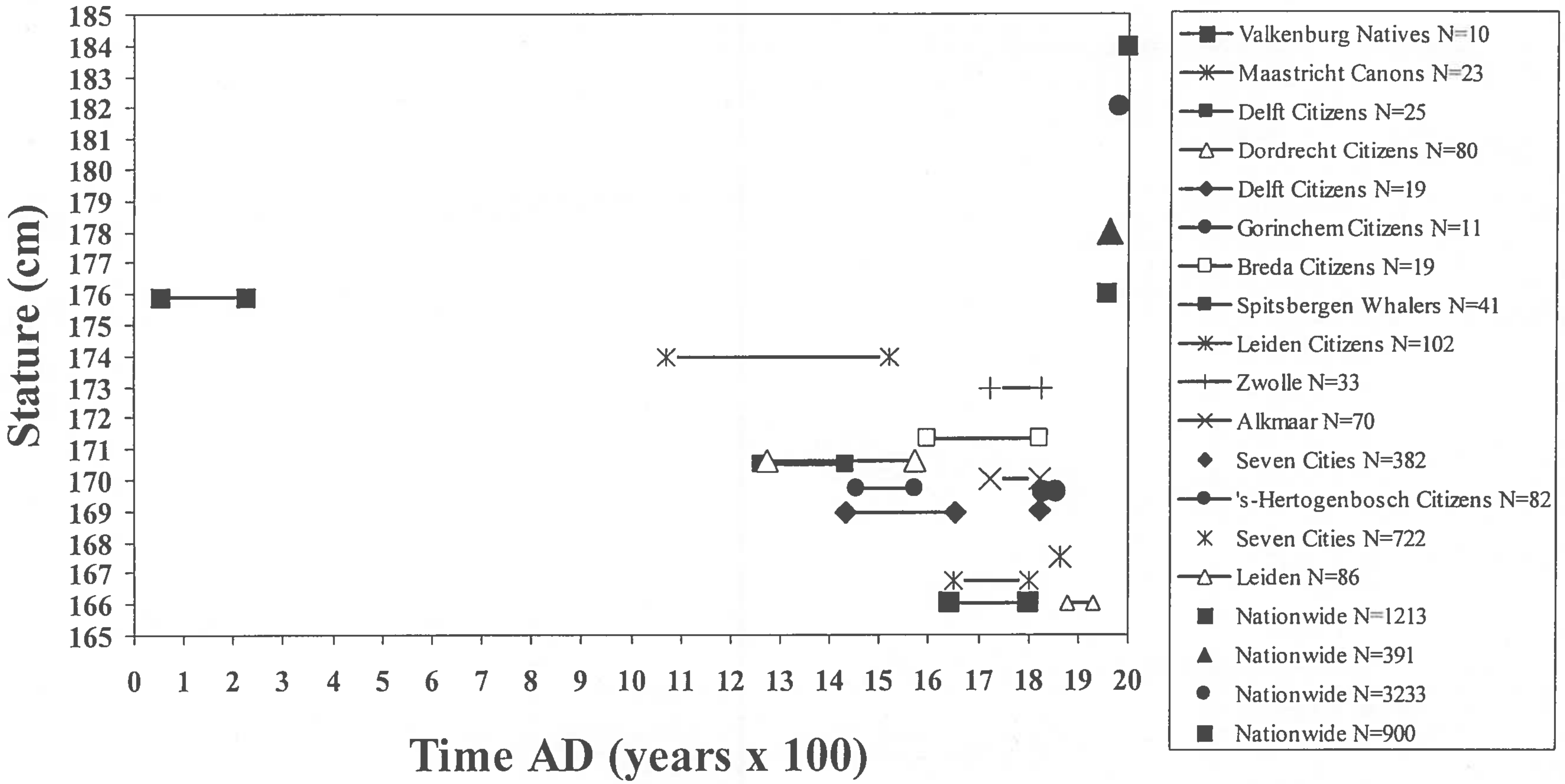


Fig. 16

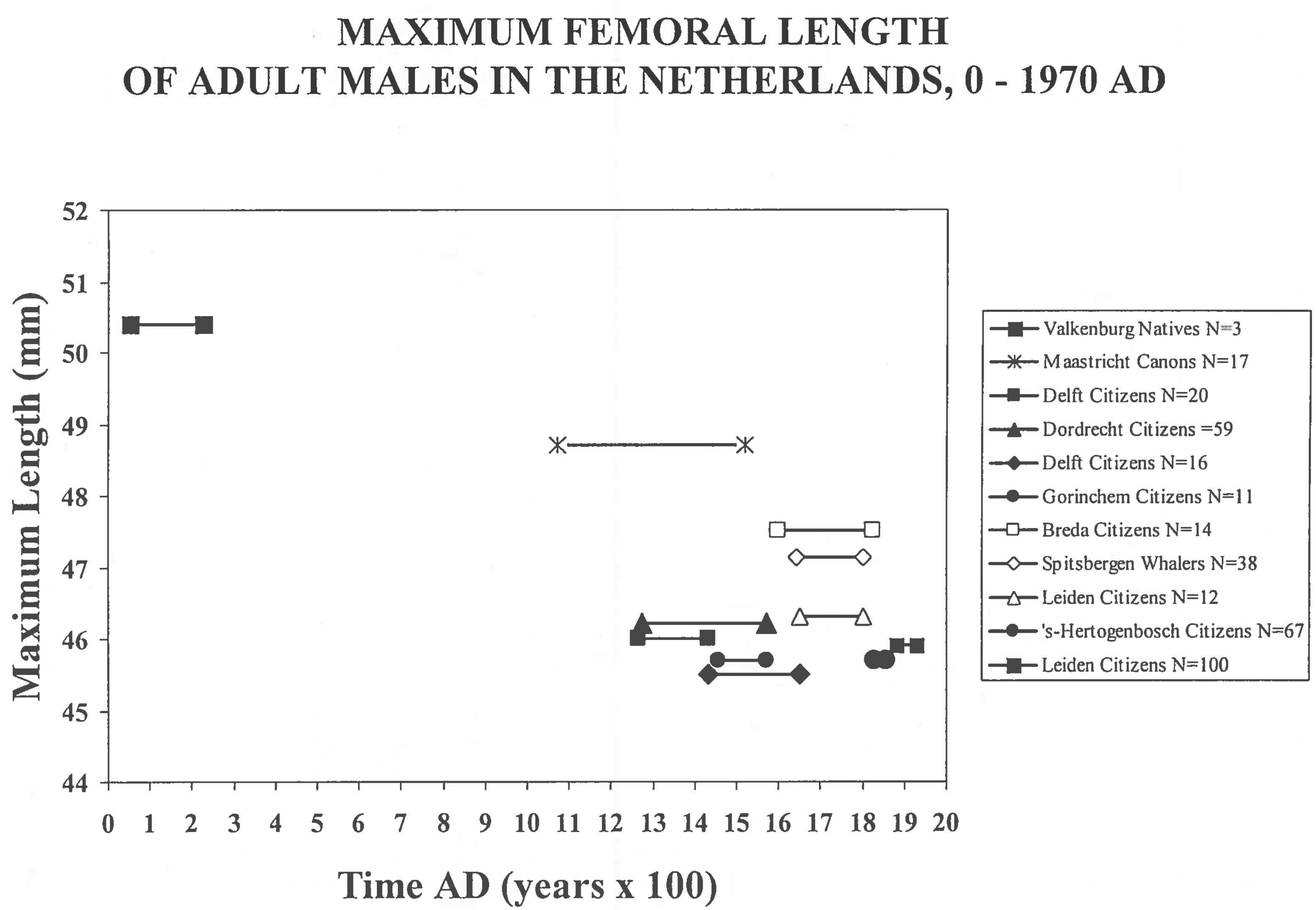

MAXIMUM FEMORAL LENGTH
OF ADULT MALES IN THE NETHERLANDS, 0 - 1970 AD
Maximum Length (mm)
52
51
50
49
48
47
46
45
44
0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20
Time AD (years x 100)
Valkenburg Natives N=3
Maastricht Canons N=17
Delft Citizens N=20
Dordrecht Citizens =59
Delft Citizens N=16
Gorinchem Citizens N=11
Breda Citizens N=14
Spitsbergen Whalers N=38
Leiden Citizens N=12
's-Hertogenbosch Citizens N=67
Leiden Citizens N=100

Fig. 17

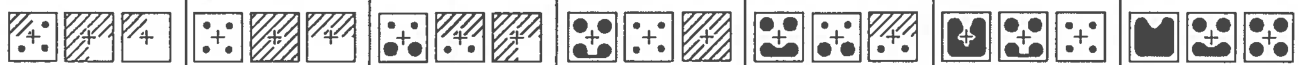
MOLAR ATTRITION DURING THE PRE-MEDIAEVAL PERIOD[1]

AGE INTERVAL (years)[2]	17 - 25			25 - 35			35 - 45			45+		
MOLAR	M1	M2	M3	M1	M2	M3	M1	M2	M3	M1	M2	M3
NUMERICAL CLASSIFICATION	3	2^+	1	4^+	4^-	3^-	5^+	5	4^+	Any greater degree		
WEAR PATTERN										Any greater degree		

[1] Modified from Brothwell (1972), and scored according to Maat and van der Velde (1987). Several early British groups.
[2] Ages are skeletal ages assessed by the pubic symphyseal face.

Fig. 18

MOLAR ATTRITION DURING THE PERIOD ca. 1275 - 1572, AD*

AGE INTERVAL (years)**	14 - 17			17 - 25			25 - 35			35 - 45			45 - 55			55 - 65			65 - 70+		
MOLAR	M1	M2	M3	M1	M2	M3	M1	M2	M3	M1	M2	M3	M1	M2	M3	M1	M2	M3	M1	M2	M3
NUMERICAL CLASSIFICATION	3^-	$2^-/2$	1^+	$3^-/3$	2	$1^+/2^-$	$3/3^+$	$2^+/3^-$	$2^-/2$	4^-	$3^-/3$	$2/2^+$	4	$3/3^+$	$2^+/3^-$	$4^+/5^-$	4^-	3	$5^-/5$	4	3^+
WEAR PATTERN																					

* Scored according to Brothwell (1972), and Maat and Van der Velde (1987). N = 76 citizens buried in a churchyard of a Fransiscan friary in the City of Dordrecht i.e., 3, 11, 19, 15, 14, 10 and 4 cases for the successive age intervals.
** Ages are skeletal ages assessed according to the WEA (1980).

Fig. 19

MOLAR ATTRITION DURING THE PERIOD ca. 1650 - 1800 AD*

AGE INTERVAL (years)**	14 - 17			17 - 25			25 - 35			35 - 45			45 - 55			55 - 65			65 - 70+		
MOLAR	M1	M2	M3	M1	M2	M3	M1	M2	M3	M1	M2	M3	M1	M2	M3	M1	M2	M3	M1	M2	M3
NUMERICAL CLASSIFICATION	2^+	$1^+/2^-$	1	$2^+/3^-$	2	$1/1^+$	$3^-/3$	$2/2^+$	$2^-/2$	$3^+/4^-$	$2^+/3^-$	$2/2^+$	$3^+/4^-$	$2^+/3^-$	2^+	4^-	$3^-/3$	$2^+/3^-$	5^-	$4^-/4$	$3/3^+$
WEAR PATTERN																					

* Scored according to Brothwell (1972), and Maat and Van der Velde (1987). N = 45 whalers with complete dentitions buried on Spitsbergen (Maat and Van der Velde, 1987) i.e., 2, 7, 9, 9, 3, 12 and 3 cases for the successive age intervals.
** Ages are skeletal ages assessed according to the WEA (1980).

Fig. 20

MOLAR ATTRITION DURING THE PERIOD ca. 1830 - 1858 AD*

AGE INTERVAL (years)**	14 - 17			17 - 25			25 - 35			35 - 45			45 - 55			55 - 65			65 - 70+		
MOLAR	M1	M2	M3	M1	M2	M3	M1	M2	M3	M1	M2	M3	M1	M2	M3	M1	M2	M3	M1	M2	M3
NUMERICAL CLASSIFICATION	$2/2^+$	$2^-/2$	$1/1^+$	$2^+/3^-$	2	$1^+/2^-$	$3^-/3$	$2/2^+$	$2^-/2$	$3/3^+$	$2^+/3^-$	$2/2^+$	$3^+/4^-$	$3^-/3$	$2^+/3^-$	$4^-/4$	$3/3^+$	$3^-/3$	$4/4^+$	$3^+/4^-$	3^+
WEAR PATTERN																					

* Scored according to Brothwell (1972), and Maat and Van der Velde (1987). N = 60 citizens buried in the 'Sint Janskerkhof' in the city of 's-Hertogenbosch i.e., 4,14,16, 9, 8, 7 and 2 individuals for successive age intervals.
** Ages are skeletal ages assessed according to the WEA (1980).

Fig. 21

Fig. 22

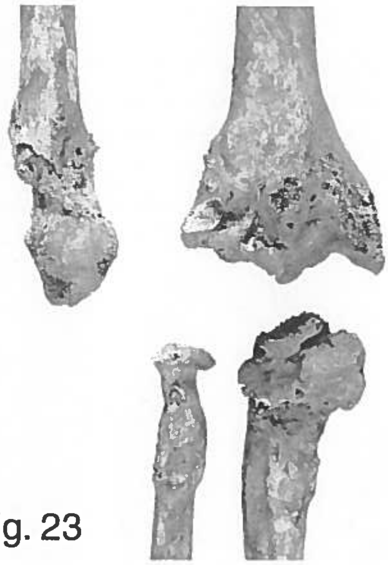


Fig. 23

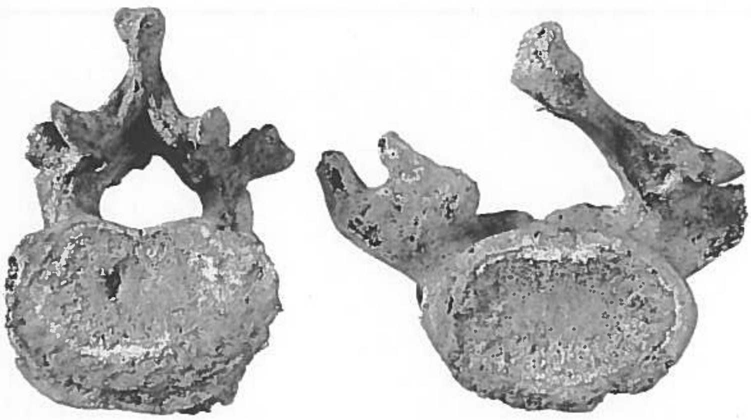


Fig. 24

Fig. 25

Fig. 26

Fig. 27

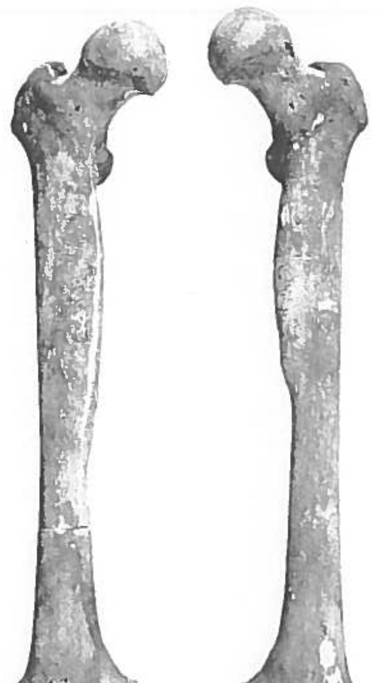


Fig. 28

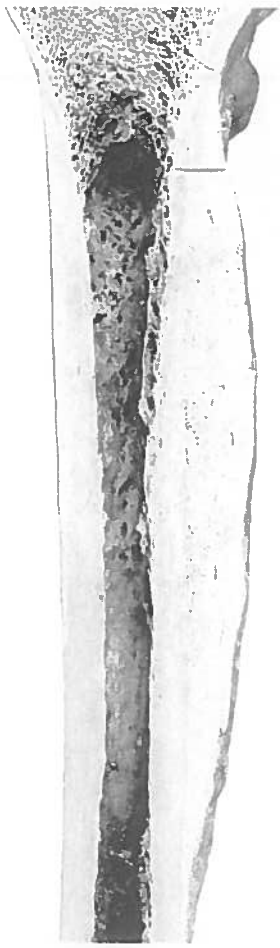


Fig. 29

Fig. 30

Fig. 31

Fig. 32

Fig. 33

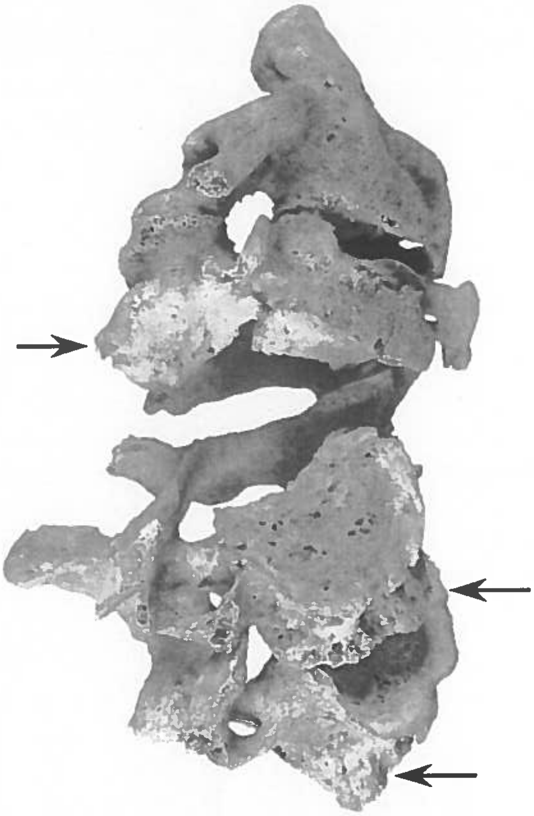


Fig. 34

Fig. 35

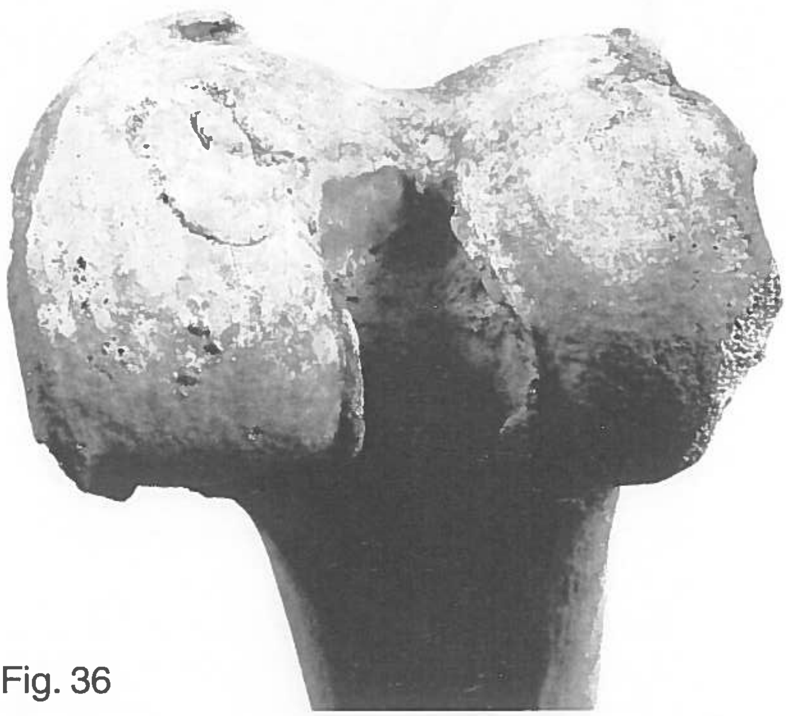


Fig. 36

Fig. 37

Fig. 38

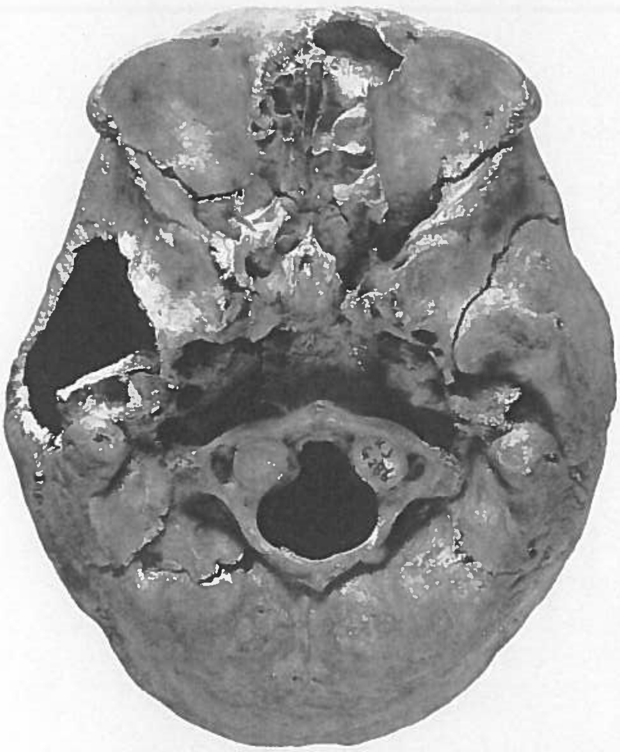


Fig. 39

Fig. 40

Fig. 41

Fig. 42

Fig. 43

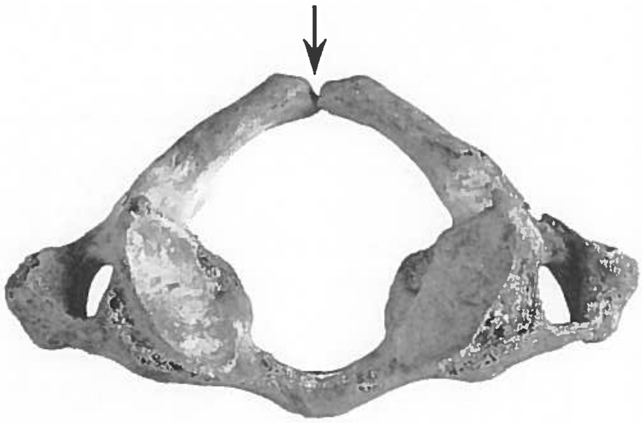


Fig. 44

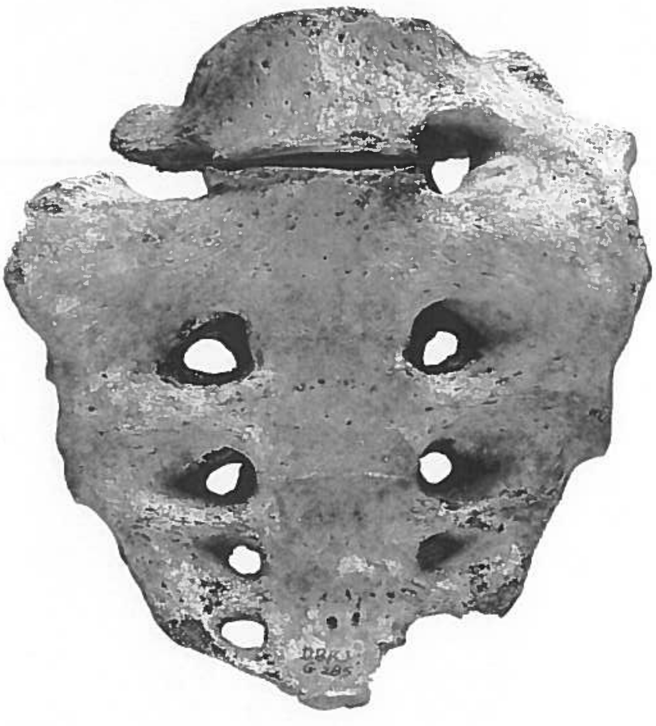


Fig. 45

Table 1. TOTAL COUNT OF MAJOR BONES FROM ADULTS
(316 individually distinct, but incomplete, skeletons)

Bone	Right	Left	Total
Cranium			148
Mandible			129
Atlas			82
Spine*			195
Spine**			160
Sacrum			130
Clavicle	96	95	191
Humerus	124	119	243
Radius	107	116	223
Ulna	113	123	236
Femur	167	168	335
Tibia	112	121	233
Fibula	88	85	173

* vertebras present
** most vertebras present

Table 2. **MAIN DEMOGRAPHIC DATA PER INDIVIDUAL (1830-1858 AD)**
(individually distinct, but incomplete, skeletons)

Grave Nr.	Status (1)	Cranial index	Pelvis (2)	Pelvis (3)	Cranium (2)	Cranium (3)	SEX (4)	AGE Min. (5)	AGE Max. (6)	Interval (7)	Trotter (cm; '58,'70)	Breitinger (cm; 1937)	Stain (8)	Main paleopathology (9)	Grave Nr.
1	1	.	0.67	15	1.6	15	1	48.5	53.5	5	.	.		DDD, vOA, pOA	1
2	1	73	0.79	14	0.53	17	1	22	24	2	171.8	171.5		trauma, costa bifida, spina bifida occulta sacralis	2
3	1	.	1.5	10	.	.	1	40	60	.	174.5	175.3		osteomyelitis, DDD, pOA	3
4	1	80.6	1.07	14	0.96	24	1	33	39	3	175.6	173.4	+	atlanto-occipital fusion, spina bifida occulta atlantis	4
5	2	.	.	.	.	.	.	.	.	.	.	.		DDD, pOA	5
6	1	.	.	.	1.71	7	1	41	47	4	.	.		DDD, vOA, pOA	6
7	1	.	.	.	.	.	3	4	4	0	.	.		cribra femora	7
8	1	.	-1.21	19	.	.	2	33	39	3	163.7	.		trauma, DDD	8
9	1	.	.	.	.	.	3	10	10	1	.	.	+	cribra femora, DDD, vOA	9
10	1	.	-1.1	10	.	.	2	51	60	5	164.5	.			10
11	1	.	1.29	14	.	.	1	20	26	2	176.4	.		trauma	11
12	1	72	-0.87	15	-0.88	24	2	55	61	5	155.6	.		trauma, DDD, vOA	12
13	1	.	-0.3	10	-1.25	24	2	30	36	3	158.6	.	+	trauma, DISH	13
14	1	.	-1.43	7	-0.25	24	2	65.3	71.3	6	168.9	.		trauma, DDD, vOA	14
15	1	.	.	.	.	.	3	0	0.2	0	.	.			15
16	1	.	-1.75	8	-0.8	10	2	47	56	.	164.5	.		trauma, vOA, pOA	16
17	2	.	.	.	.	.	.	.	.	.	.	.			17
18	1	.	.	.	.	.	3	40	60	.	155.4	.	+	trauma, osteomyelitis, vOA, pOA	18
19	1	.	.	.	.	.	3	10	13	1	.	.		cribra femora	19
20	1	.	0.4	5	.	.	1	57	65	.	171.1	170.1		vOA, pOA	20
21	1	.	0.42	12	.	.	1	23	40	.	163	163.3		rickets	21
22	1	.	0.83	12	.	.	1	52	60	5	173.3	171.6		cribra femora, DDD	22
23	1	.	-1.75	8	.	.	2	51	60	5	148.4	.		trauma, DDD, atlanto-occipital fusion	23
24	1	.	-1.64	14	.	.	2	21	23	2	161.8	.	+	cribra femora	24
25	1	.	1.6	15	.	.	1	54	60	5	175.9	174.9	+	trauma, DISH	25
26	2	.	.	.	.	.	.	.	.	.	.	.			26
27	1	.	-1	15	.	.	2	35	55	.	.	.		trauma, cribra femora, DDD, vOA, pOA	27

Grave Nr.	Status (1)	Cranial index	Pelvis (2)	Pelvis (3)	Cranium (2)	Cranium (3)	SEX (4)	AGE Min. (5)	AGE Max. (6)	Interval (7)	Trotter (cm; '58,'70)	Breitinger (cm; 1937)	Stain (8)	Main paleopathology (9)	Grave Nr.
28	1	76.5	0.9	10	0.63	24	1	40	49	4	164.5	165.5		vOA, pOA	28
29.1	1	.	-0.95	19	-1.2	15	2	45.8	50.8	4	155.7	.	+	cribra femora, DDD, vOA, pOA	29.1
29.2	1	.	.	.	.	.	1	16.5	18	1	.	.		DDD	29.2
30	1	.	.	.	.	.	3	15	18	1	.	.	+		30
31	1	.	1.25	8	.	.	1	23	40	.	175.7	173.3		trauma, osteochondroma, vOA, pOA	31
32	1	.	.	.	.	.	3	12	19	1	.	.		cribra femora	32
33	3	.	.	.	.	.	.	.	.	.	.	.			33
34	1	.	.	.	.	.	3	30	60	.	.	.			34
35	1	.	-0.75	12	-1.12	17	2	42.3	48.3	4	162.8	.		trauma, osteoma, Reiter's syndrome	35
36	3	.	.	.	.	.	.	.	.	.	.	.			36
37	1	.	1	8	.	.	1	.	.	.	.	.		Paget's disease	37
38	1	.	-1	8	-1	7	2	48	56	.	154.9	.	+	osteochondroma, osteochondritis dissecans	38
39	1	.	-1.5	12	.	.	2	35	55	.	165.2	.		DDD, osteochondritis dissecans	39
40	3	.	.	.	.	.	.	.	.	.	.	.			40
41	3	.	.	.	.	.	.	.	.	.	.	.			41
42	1	.	.	.	.	.	3	40	60	.	160.6	.		cribra femora, gout	42
43	1	.	.	.	1	2	1	.	.	.	.	.			43
44	1	.	.	.	-1	21	2	23	34	.	.	.		trauma	44
45	1	80.7	.	.	0.56	18	1	34	34	3	.	.			45
46	1	.	.	.	.	.	3	15	18	1	.	.		osteochondroma	46
47	3	.	.	.	.	.	.	.	.	.	.	.			47
48	2	.	.	.	.	.	.	.	.	.	.	.			48
49.1	2	.	.	.	.	.	.	.	.	.	.	.			49.1
49.2	1	.	.	.	.	.	3	17	20	1	.	.			49.2
50	3	.	.	.	.	.	.	.	.	.	.	.			50
51	1	82.3	-2	6	-1.17	24	2	21	22	2	158.1	.	+	trauma, cribra femora, DDD	51
52	3	.	.	.	.	.	.	.	.	.	.	.			52
53	1	.	-1.22	19	.	.	2	21	22	2	.	.			53
54	1	79	.	.	0.96	24	1	40	80	4	.	.			54

Grave Nr.	Status (1)	Cranial index	Pelvis (2)	Pelvis (3)	Cranium (2)	Cranium (3)	SEX (4)	AGE Min. (5)	AGE Max. (6)	Interval (7)	Trotter (cm; '58,'70)	Breitinger (cm; 1937)	Stain (8)	Main paleopathology (9)	Grave Nr.
55	3	.	.	.	.	.	.	.	.	.	.	.			55
56	2	.	.	.	.	.	.	.	.	.	.	.			56
57	3	.	.	.	.	.	.	.	.	.	.	.			57
58	1	77.2	.	.	0.83	24	1	40	80	4	.	.			58
59	1	.	.	.	.	.	3	35	55	.	.	.			59
60	2	.	.	.	.	.	.	.	.	.	.	.			60
61	2	.	.	.	.	.	.	.	.	.	.	.			61
62	3	.	.	.	.	.	.	.	.	.	.	.			62
63	2	.	.	.	.	.	.	.	.	.	.	.			63
64	1	81.9	-0.1	13	-0.21	24	2	44.3	50.3	4	169.2	.		mastoiditis, DDD, pOA	64
65	1	79	.	.	0.78	23	1	40	80	5	.	.			65
66	1	76.5	.	.	1.25	24	1	40	80	4	.	.			66
67	1	76.7	.	.	-1.21	24	2	18	22	2	.	.	+		67
68	1	.	.	.	.	.	3	40	60	.	169.9	168.2		rickets	68
69	1	.	1.2	10	1.45	11	1	62	71	.	183	175.4	+	periostitis, osteochondroma, DDD	69
70	1	82.6	0.85	13	0.7	20	1	21	21	2	166.4	166.9	+	trauma, spina bifida occulta sacralis	70
71	1	.	.	.	.	.	3	40	48	4	.	.		trauma, DDD	71
72	3	.	.	.	.	.	.	.	.	.	.	.			72
73	1	.	-0.12	17	.	.	2	51	60	5	159.8	.		DDD, vOA, pOA, osteochondritis dissecans	73
74	1	.	1.63	8	.	.	1	18	.	.	174.5	171.3		osteomyelitis, DDD, vOA, pOA, osteochondritis dissecans	74
75	2	.	.	.	.	.	.	.	.	.	.	.			75
76	3	.	.	.	.	.	.	.	.	.	.	.			76
77	1	74.2	-0.93	15	-0.58	24	2	62.5	67.5	6	162.2	.		trauma, DDD	77
78	3	.	.	.	.	.	.	.	.	.	.	.			78
79	2	.	.	.	.	.	.	.	.	.	.	.			79
80	3	.	.	.	.	.	.	.	.	.	.	.			80
81	3	.	.	.	.	.	.	.	.	.	.	.			81
82	1	.	0.88	16	.	.	1	40	48	4	165.2	165.7		cribra orbitalia	82
83	1	.	-1.32	19	.	.	2	55	63	.	160.8	.		osteochondritis dissecans, spina bifida occulta sacralis	83

Grave Nr.	Status (1)	Cranial index	Pelvis (2)	Pelvis (3)	Cranium (2)	Cranium (3)	SEX (4)	AGE Min. (5)	AGE Max. (6)	Interval (7)	Trotter (cm; '58,'70)	Breitinger (cm; 1937)	Stain (8)	Main paleopathology (9)	Grave Nr.
84	1	.	.	.	.	.	3	.	.	.	.	.		trauma, DDD, vOA, pOA, gout	84
85	1	.	-1.37	19	-0.3	10	2	52.5	57.5	5	157.6	.	+	DDD, vOA, pOA	85
86	1	.	.	.	.	.	3	17	17	1	.	.		trauma	86
87	2	.	.	.	.	.	.	.	.	.	.	.			87
88	1	.	0.75	12	0.79	14	1	54.3	60.3	5	169.4	169.4	+	trauma, periostitis, DDD, vOA, autopsy	88
89	1	77.1	1	12	1.21	24	1	66.7	72.7	6	168.5	172.5	+	trauma, DISH, spina bifida occulta sacralis	89
90	1	.	-1.2	10	.	.	2	23	25	2	154.4	.		cribra femora, spina bifida occulta sacralis	90
91	1	.	-1.17	12	.	.	2	48	56	.	153.6	.	+	cribra femora	91
92	1	.	-1	8	.	.	2	21	22	2	163.5	.		cribra femora, spina bifida occulta sacralis	92
93	2	.	.	.	.	.	.	.	.	.	.	.			93
94	3	.	.	.	.	.	.	.	.	.	.	.			94
95	1	.	1.47	15	.	.	1	46	52	4	159.4	160.2		osteomyelitis, spina bifida occulta sacralis	95
96	1	.	.	.	-0.75	20	2	18	18	1	157.3	.			96
97	2	.	.	.	.	.	.	.	.	.	.	.			97
98	3	.	.	.	.	.	.	.	.	.	.	.			98
99	2	.	.	.	.	.	.	.	.	.	.	.			99
100	1	79.8	.	.	-0.63	16	2	40	80	.	.	.		cribra orbitalia	100
101	1	.	.	.	.	.	1	20	24	2	.	.		periostitis	101
102	2	.	.	.	.	.	.	.	.	.	.	.			102
103	2	.	.	.	.	.	.	.	.	.	.	.			103
104	2	.	.	.	.	.	.	.	.	.	.	.			104
105	3	.	.	.	.	.	.	.	.	.	.	.			105
106	3	.	.	.	.	.	.	.	.	.	.	.			106
107	3	.	.	.	.	.	.	.	.	.	.	.			107
108	3	.	.	.	.	.	.	.	.	.	.	.			108
109	3	.	.	.	.	.	.	.	.	.	.	.			109
110	3	.	.	.	.	.	.	.	.	.	.	.			110
111	3	.	.	.	.	.	.	.	.	.	.	.			111
112	3	.	.	.	.	.	.	.	.	.	.	.			112

Grave Nr.	Status (1)	Cranial index	Pelvis (2)	Pelvis (3)	Cranium (2)	Cranium (3)	SEX (4)	AGE Min. (5)	AGE Max. (6)	Interval (7)	Trotter (cm; '58,'70)	Breitinger (cm; 1937)	Stain (8)	Main paleopathology (9)	Grave Nr.
113	1	.	.	.	-1.29	23	2	40	80	4	.	.	+		113
114	1	.	-1.25	12	.	.	2	.	.	.	160.2	.		rickets, pOA	114
115	3	.	.	.	.	.	.	.	.	.	.	.			115
116	3	.	.	.	.	.	.	.	.	.	.	.			116
117	1	.	.	.	0.67	15	1	34	60	3	.	.			117
118	1	.	1.2	10	.	.	1	40	60	.	.	.		trauma, osteoporosis, DISH	118
119	3	.	.	.	.	.	.	.	.	.	.	.			119
120	2	.	.	.	.	.	.	.	.	.	.	.			120
121	2	.	.	.	.	.	.	.	.	.	.	.			121
122	2	.	.	.	.	.	.	.	.	.	.	.			122
123	1	.	-1.45	11	-0.92	13	2	46	62	4	.	.	+	trauma, DDD, vOA	123
124	1	.	-1.3	10	.	.	2	21	24	2	.	.		pOA	124
125	3	.	.	.	.	.	.	.	.	.	.	.			125
126	1	.	.	.	.	.	3	4	6	0	.	.	+	meningitis	126
127	1	.	.	.	.	.	3	0	0.3	0	.	.			127
128	1	.	.	.	.	.	3	-0.4	-0.4	-1	.	.			128
129	1	.	.	.	.	.	3	2	2	0	.	.	+	cribra femora, microcephaly	129
130	1	.	.	.	.	.	3	0	0.2	0	.	.			130
131	1	.	.	.	.	.	3	1	1	0	.	.		periostitis, cribra femora	131
132.1	1	.	.	.	.	.	3	0.3	0.8	0	.	.			132.1
132.2	1	.	.	.	.	.	3	4	4	0	.	.			132.2
133	1	.	.	.	.	.	3	0	0.3	0	.	.		cribra orbitalia	133
134	1	.	.	.	.	.	3	-0.2	-0.2	-1	.	.	+		134
135	2	.	.	.	.	.	.	.	.	.	.	.			135
136	3	.	.	.	.	.	.	.	.	.	.	.			136
137	1	.	.	.	.	.	3	15	20	1	.	.		cribra femora	137
138.1	1	.	.	.	.	.	3	0	0.8	0	.	.	+		138.1
138.2	1	.	.	.	.	.	3	-0.4	-0.4	-1	.	.			138.2
139	1	.	.	.	.	.	3	-0.4	-0.4	-1	.	.			139

Grave Nr.	Status (1)	Cranial index	Pelvis (2)	Pelvis (3)	Cranium (2)	Cranium (3)	SEX (4)	AGE Min. (5)	AGE Max. (6)	Interval (7)	Trotter (cm; '58,'70)	Breitinger (cm; 1937)	Stain (8)	Main paleopathology (9)	Grave Nr.
140	1	.	.	.	.	.	3	1	2	0	.	.			140
141	3	.	.	.	.	.	.	.	.	.	.	.			141
142	1	.	.	.	.	.	3	4	6	0	.	.			142
143	2	.	.	.	.	.	.	.	.	.	.	.			143
144.1	1	.	.	.	.	.	3	-0.2	-0.2	-1	.	.			144.1
144.2	1	.	.	.	.	.	3	0	0	0	.	.			144.2
145.1	3	.	.	.	.	.	.	.	.	.	.	.			145.1
145.2	3	.	.	.	.	.	.	.	.	.	.	.			145.2
146	1	.	.	.	.	.	3	3	3	0	.	.		cribra femora	146
147	1	.	-1.38	13	-0.92	24	2	34	40	3	160.1	.	+	cribra femora, DDD, vOA, pOA, costo-clavicular articulation	147
148	1	.	-1.21	14	.	.	2	47	56	.	171.1	.		Scheuermann's disease	148
149	3	.	.	.	.	.	.	.	.	.	.	.			149
150	1	.	.	.	.	.	3	5	6	0	.	.			150
151	2	.	.	.	.	.	.	.	.	.	.	.			151
152	2	.	.	.	.	.	.	.	.	.	.	.			152
153	1	.	.	.	.	.	3	2	2.5	0	.	.	+	pleuritis, meningitis, cribra femora	153
154	1	.	.	.	.	.	3	0.5	0.8	0	.	.			154
155	1	.	.	.	.	.	3	0	0.2	0	.	.			155
156	1	.	.	.	.	.	3	2	2	0	.	.		cribra orbitalia	156
157	1	.	1.07	14	.	.	1	40	48	4	163.4	163.7		trauma, DISH, spina bifida occulta sacralis	157
158	1	.	-0.77	13	.	.	2	18	19	1	171.1	.	+	Calvé-Perthes disease, spina bifida occulta sacralis	158
159	1	.			.	.	3	0	0.2	0	.	.			159
160	2	.	.	.	.	.	.	.	.	.	.	.			160
161	2	.	.	.	.	.	.	.	.	.	.	.			161
162	2	.	.	.	.	.	.	.	.	.	.	.			162
163	2	.	.	.	.	.	.	.	.	.	.	.			163
164	1	.	-1.64	11	-1.15	13	2	35.7	41.7	3	167.3	.		trauma, DDD, vOA	164
165	1	.	-0.62	13	.	.	2	39.7	45.7	4	163.5	.		cribra femora, Reiter's syndrome	165
166	1	.	.	.	.	.	3	-0.2	-0.2	-1	.	.			166

Grave Nr.	Status (1)	Cranial index	Pelvis (2)	Pelvis (3)	Cranium (2)	Cranium (3)	SEX (4)	AGE Min. (5)	AGE Max. (6)	Interval (7)	Trotter (cm; '58,'70)	Breitinger (cm; 1937)	Stain (8)	Main paleopathology (9)	Grave Nr.
167	1	.	-0.95	19	.	.	2	34	43	.	158.6	.	+	trauma, cribra femora, DDD, vOA, pOA	167
168	1	.	1	19	1.38	13	1	36.3	42.3	3	170.5	170.3	+	trauma, DISH	168
169	1	.	1.31	13	.	.	1	25	34	.	188.2	181.5	+	trauma, periostitis	169
170	1	.	-0.84	19	-0.47	15	2	41.7	47.7	4	153.7	.		osteochondritis dissecans	170
171	1	.	0.71	14	-1.43	14	1	18	19	1	.	.		cribra orbitalia, cribra femora, DDD, spina bifida occulta sacralis	171
172	1	.	1	8	.	.	1	40	60	.	.	.		trauma, DDD	172
173	1	.	.	.	1.77	13	1	38	56	.	177.6	176.6		DDD, vOA	173
174	1	.	.	.	.	.	1	50	59	5	166.1	164.3	+	osteomyelitis, DISH	174
175	1	.	-1.11	9	-1.23	13	2	30	36	3	155.6	.		DDD, spina bifida occulta sacralis	175
176	1	.	-0.7	10	-0.56	16	2	26	28	2	171.3	.	+	trauma, cribra orbitalia, DDD, vOA	176
177	1	.	1.29	14	0.1	10	1	20	21	2	170.3	169.4		cribra femora, autopsy, spina bifida occulta sacralis	177
178	1	.	0.86	14	0.5	16	1	21	22	2	174.2	174.3		cribra femora	178
179	1	.	.	.	.	.	3	5	5.5	0	.	.			179
180	1	75	-1	12	-1.48	23	2	58.7	64.7	6	154.1	.	+	trauma, facial nerve paralysis, cribra femora, gout, scoliosis, spina bifida occulta atlantis	180
181	2	.	.	.	.	.	.	.	.	.	.	.		von Bechterew's disease	181
182	1	76.1	-0.43	7	-1.17	24	2	49	64	4	158.4	.	+		182
183	1	68	1.23	13	1.13	24	1	39.7	45.7	4	171.6	170.2		trauma, osteoma, DDD, vOA, pOA	183
184	1	76.3	1.18	17	0.92	24	1	61	66	6	162.6	166.5		trauma	184
185	1	80.7	-0.89	19	0.17	24	2	18	19	1	.	.		osteomyelitis, cribra orbitalia, osteoma	185
186	1	.	0.93	15	.	.	1	28	36	.	180.9	175.9	+	periostitis, osteoma, pOA, spina bifida occulta sacralis	186
187	1	.	.	.	-0.5	5	2	.	.	.	.	.		trauma	187
188	1	.	-0.92	12	.	.	2	40	60	.	172.4	.		trauma, cribra femora, DDD	188
189	1	75.4	1	9	1.13	24	1	21	22	2	165.2	165.1	+	cribra femora, spina bifida occulta sacralis	189
190	1	.	.	.	-1.25	24	2	51.3	57.3	5	156.4	.	+	DISH, osteochondritis dissecans	190
191.1	1	.	.	.	0.75	8	1	56	70	.	.	.		trauma	191.1
191.2	1	.	0.88	8	1.3	10	1	64	73	.	.	.		DDD, vOA, pOA, DISH, spina bifida occulta sacralis	191.2
191.3	1	.	0.92	12	.	.	1	22	24	2	.	.		DDD, fusion of vertebral arch Th3-4	191.3
192	1	.	.	.	.	.	3	15	18	1	.	.		cribra femora	192
193.1	2	.	.	.	.	.	.	.	.	.	.	.			193.1

Grave Nr.	Status (1)	Cranial index	Pelvis (2)	Pelvis (3)	Cranium (2)	Cranium (3)	SEX (4)	AGE Min. (5)	AGE Max. (6)	Interval (7)	Trotter (cm; '58,'70)	Breitinger (cm; 1937)	Stain (8)	Main paleopathology (9)	Grave Nr.
193.2	2	.	.	.	.	.	.	.	.	.	.	.			193.2
194	2	.	.	.	.	.	.	.	.	.	.	.			194
195	2	.	.	.	.	.	.	.	.	.	.	.			195
196.1	1	79.1	-1.46	13	-1.44	18	2	52.3	58.3	5	161.1	.		DISH, spina bifida occulta sacralis	196.1
196.2	1	.	.	.	-1.5	18	2	40	80	.	.	.			196.2
197	2	.	.	.	.	.	.	.	.	.	.	.			197
198.1	2	.	.	.	.	.	.	.	.	.	.	.			198.1
198.2	2	.	.	.	.	.	.	.	.	.	.	.			198.2
198.3	2	.	.	.	.	.	.	.	.	.	.	.			198.3
199.1	1	.	.	.	-1	15	2	40	80	4	153.7	.			199.1
199.2	1	.	.	.	.	.	3	.	.	.	.	.		cribra orbitalia,	199.2
200	1	.	-1.2	10	.	.	2	40	60	.	.	.		suppuratve arthritis, rickets, cribra femora, pOA	200
201	1	.	-0.9	10	.	.	2	40	60	.	157.5	.		DDD, osteochondritis dissecans, scoliosis	201
202	1	.	-1.3	10	-1.19	16	2	54	60	5	160.8	.		DISH	202
203	1	.	-1.2	10	.	.	2	40	60	.	168.1	.	+	cribra femora, vOA	203
204	1	.	.	.	.	.	1	40	60	.	178.3	175.1			204
205	2	.	.	.	.	.	.	.	.	.	.	.	+		205
206	1	.	0.8	10	.	.	1	51	66	.	166.1	166.3		DDD	206
207	1	.	-1.09	11	-1.11	18	2	22	23	2	162.8	.	+	cribra femora, DDD, vOA, scoliosis	207
208	1	.	1	9	.	.	1	34	43	.	177.8	174.5	+	trauma, DISH, scoliosis	208
209	1	.	-0.62	13	-0.94	18	2	21	23	2	154.5	.	+	tuberculosis	209
210	1	.	-0.2	5	.	.	2	30	60	.	.	.	+		210
211	1	.	.	.	.	.	3	0.5	1	0	.	.			211
212	1	.	0.92	12	.	.	1	51	57	5	176.5	174.4		DDD, vOA, pOA	212
213	1	.	0.9	10	1.17	18	1	26	32	2	172.8	171.4			213
214	1	78.4	-0.83	12	-1.39	23	2	21	24	2	163	.	+	periostitis, cribra femora	214
215	1	.	.	.	0.94	16	1	53	68	.	162.9	164.7			215
216	1	.	0.8	10	0.5	10	1	30	34	3	166.4	166.6		trauma, DDD, vOA	216
217	3	.	.	.	.	.	.	.	.	.	.	.			217

Grave Nr.	Status (1)	Cranial index	Pelvis (2)	Pelvis (3)	Cranium (2)	Cranium (3)	SEX (4)	AGE Min. (5)	AGE Max. (6)	Interval (7)	Trotter (cm; '58,'70)	Breitinger (cm; 1937)	Stain (8)	Main paleopathology (9)	Grave Nr.
218	1	.	-0.83	12	.	.	2	40	60	.	.	.		osteomyelitis	218
219	1	.	-0.9	10	.	.	2	35	55	.	156.9	.		osteomyelitis, cribra femora, osteochon.diss., spina bif.occ.sacr.	219
220	1	.	0.89	18	0.35	20	1	40	48	4	172.1	170.8		DDD	220
221	1	.	0.83	12	0.65	23	1	20	26	2	169.7	169.9		trauma, cribra femora, DDD	221
222	1	.	.	.	.	.	3	12	14	1	.	.		autopsy	222
223	1	.	.	.	0.4	20	1	34	40	3	.	.			223
224	1	.	.	.	.	.	3	5	5	0	.	.			224
225	1	.	1	10	.	.	1	21	24	2	177.7	174.3		DDD, vOA	225
226	1	77.6	1.58	12	1.13	24	1	53.3	59.3	5	167.1	167.8		DDD, vOA	226
227	1	.	0.6	10	2	3	1	62	68	6	.	.		trauma, periostitis, gout, spina bifida occulta sacralis	227
228	1	.	0.8	16	-0.9	10	1	24	30	2	167.4	163.9	+	DDD	228
229	1	.	.	.	.	.	3	21	22	2	.	.			229
230	3	.	.	.	.	.	.	.	.	.	.	.			230
231	1	.	-0.91	11	-0.78	23	2	46	46	4	168	.	+	trauma, DDD, vOA, pOA	231
232	1	.	-0.6	15	.	.	2	66.3	72.3	6	158	.		trauma, DDD, vOA	232
233	3	.	.	.	.	.	.	.	.	.	.	.			233
234	1	76.3	0.91	11	1.21	24	1	41.7	47.7	4	173.3	171.3	+	trauma, DISH	234
235	1	.	1	8	0.54	13	1	30	36	3	177.4	173.9	+	periostitis, osteoma	235
236	1	.	1.1	10	0.8	15	1	64	70	6	170.6	.	+	trauma, rickets, DDD	236
237	1	82.6	0.75	12	0.32	22	1	18	18	1	.	.		cribra femora, spina bifida occulta Th1	237
238	1	.	1.29	7	0.83	23	1	34	35	3	.	.	+	periostitis, osteoporosis, DISH, scoliosis	238
239	1	.	1	12	.	.	1	28	37	.	156.1	161.7		trauma, cribra femora, DDD	239
240	1	.	1.5	10	.	.	1	54	55	5	173.3	169.3	+	trauma, osteoporosis, DISH, spina bifida occulta L5	240
241	1	.	0.76	17	0.67	18	1	16	18	1	.	.	+	trauma, cribra femora	241
242.1	1	.	-0.83	12	.	.	2	22	28	2	167.3	.		DDD, vOA, scoliosis	242.1
242.2	1	.	.	.	.	.	3	6	7	0	.	.		rickets	242.2
243	2	.	.	.	.	.	.	.	.	.	.	.			243
244	1	.	.	.	.	.	3	0.5	1	0	.	.			244
245.1	2	.	.	.	.	.	.	.	.	.	.	.			245.1

Grave Nr.	Status (1)	Cranial index	Pelvis (2)	Pelvis (3)	Cranium (2)	Cranium (3)	SEX (4)	AGE Min. (5)	AGE Max. (6)	Interval (7)	Trotter (cm; '58,'70)	Breitinger (cm; 1937)	Stain (8)	Main paleopathology (9)	Grave Nr.
245.2	2	.	.	.	.	.	.	.	.	.	.	.			245.2
246	1	.	-0.5	10	-1.62	13	2	18	20	1	159.9	.		autopsy, spina bifida occulta sacralis	246
247	2	.	.	.	.	.	.	.	.	.	.	.			247
248	3	.	.	.	.	.	.	.	.	.	.	.			248
249	1	78.3	1.37	19	0.78	18	1	41.7	47.7	4	167.6	168.4	+	cribra femora, Scheuermann's disease	249
250	1	.	-0.84	19	.	.	2	48	56	.	154	.	+	trauma, Reiter's syndrome	250
251	1	.	-1.2	10	.	.	2	.	.	.	.	.		DDD, vOA	251
252	3	.	.	.	.	.	.	.	.	.	.	.			252
253	3	.	.	.	.	.	.	.	.	.	.	.			253
254	1	.	0.92	13	.	.	1	18	18	1	.	.		cribra femora	254
255	2	.	.	.	.	.	.	.	.	.	.	.			255
256	1	.	-0.94	17	-0.38	16	2	30	36	3	162.7	.		trauma, DDD, vOA, osteochon.diss., spina bifida occulta sacralis	256
257	1	.	0.92	12	.	.	1	50.7	56.7	5	178	172		DISH, spina bifida occulta sacralis	257
259	3	.	.	.	.	.	.	.	.	.	.	.	+		259
260	3	.	.	.	.	.	.	.	.	.	.	.			260
262	1	.	-2	6	.	.	2	64	73	.	163.5	.			262
263	2	.	.	.	.	.	.	.	.	.	.	.			263
264	3	.	.	.	.	.	.	.	.	.	.	.			264
265	2	.	.	.	.	.	.	.	.	.	.	.			265
266	1	.	.	.	-1.63	19	2	40	80	5	.	.		meningitis, DDD	266
267	1	.	-0.77	13	.	.	2	57	65	.	160.3	.		pOA	267
268	1	.	.	.	1.14	21	1	34	60	.	.	.			268
269	1	.	-0.32	19	.	.	2	44	52	.	164.8	.	+	trauma, pOA	269
270	3	.	.	.	.	.	.	.	.	.	.	.			270
271	3	.	.	.	.	.	.	.	.	.	.	.			271
272	3	.	.	.	.	.	.	.	.	.	.	.			272
273	2	.	.	.	.	.	.	.	.	.	.	.			273
274	2	.	.	.	.	.	.	.	.	.	.	.			274
275	1	.	.	.	1.2	10	1	22	.	.	.	.			275

Grave Nr.	Status (1)	Cranial index	Pelvis (2)	Pelvis (3)	Cranium (2)	Cranium (3)	SEX (4)	AGE Min. (5)	AGE Max. (6)	Interval (7)	Trotter (cm; '58,'70)	Breitinger (cm; 1937)	Stain (8)	Main paleopathology (9)	Grave Nr.
276	1	.	.	.	.	.	3	21	24	2	.	.			276
277	2	.	.	.	.	.	.	.	.	.	.	.			277
278	1	.	-1.37	11	.	.	2	15	19	1	.	.			278
279	1	.	-1.5	12	.	.	2	50	70	.	166	.		periostitis, pOA	279
280	3	.	.	.	.	.	.	.	.	.	.	.			280
281	1	.	1	12	.	.	1	18	18	1	.	.		gout	281
282	1	.	.	.	1.3	23	1	48	63	4	173.6	171.5		DDD, vOA	282
283	1	.	1	3	0.54	13	1	42.3	47.3	4	170.2	.	+	trauma, DDD	283
284	1	.	-1	15	.	.	2	50	75	.	165	.	+	cribra femora	284
285.1	1	.	1	16	.	.	1	54.3	60.3	5	169.5	168.3	+	DDD, vOA, pOA, spina bifida occulta sacralis	285.1
285.2	1	.	1.25	12	.	.	1	21	24	2	168.5	168.3	+	rickets	285.2
286	1	.	.	.	0	14	3	34	38	3	.	.	+	DDD, basilar impression	286
287	2	.	.	.	.	.	.	.	.	.	.	.			287
288	1	.	1.5	10	1.06	16	1	51.3	57.3	5	167.5	167.8	+	cribra femora, DISH, spina bifida occulta sacralis	288
289	2	.	.	.	.	.	.	.	.	.	.	.			289
290	1	74.6	-1.5	12	-1.25	24	2	64	70	6	160	.		trauma, pOA	290
291	1	.	-1.55	11	.	.	2	23	25	2	155.4	.	+		291
292	2	.	.	.	.	.	.	.	.	.	.	.		trauma	292
293	1	.	0.88	16	.	.	1	37	44	4	181.2	174.5		trauma, periostitis, cribra femora, DDD, vOA	293
294	1	81.7	-0.9	10	-0.1	20	2	34	40	3	153.8	.	+	trauma, DDD, vOA, scoliosis	294
295.1	1	.	0.94	16	.	.	1	48	56	.	175.6	171.5	+	trauma	295.1
295.2	1	.	-0.83	12	.	.	2	20	21	2	.	.	+	spina bifida occulta sacralis	295.2
296	1	.	1.8	10	.	.	1	40	60	.	172.1	170.8		pOA	296
297	1	.	1.08	12	.	.	1	35	55	.	167.1	166.4	+	DDD, spina bifida occulta sacralis	297
298	1	.	0.5	16	.	.	1	20	21	2	.	.		cribra femora, DDD	298
299	1	.	1.45	11	.	.	1	30	35	3	169.4	169.4			299
300	1	.	0.82	17	1	2	1	31.5	36.5	3	177.5	174.6		cribra femora, DDD, pOA, autopsy	300
301	3	.	.	.	.	.	.	.	.	.	.	.			301
302	1	.	-1.2	10	.	.	2	60	70	6	154	.		trauma, cribra femora, pOA, gout, spina bif.occ.atlantis et sacr.	302

Grave Nr	Status (1)	Cranial index	Pelvis (2)	Pelvis (3)	Cranium (2)	Cranium (3)	SEX (4)	AGE Min. (5)	AGE Max. (6)	Interval (7)	Trotter (cm; '58,'70)	Breitinger (cm; 1937)	Stain (8)	Main paleopathology (9)	Grave Nr.
303	1	.	0.77	13	.	.	1	25	30	2	176.7	173.9		trauma, DDD	303
304	1	.	0.73	15	.	.	1	51	60	5	162.6	163.9		DDD, vOA	304
305	2	.	.	.	.	.	.	.	.	.	.	.			305
306	1	.	.	.	.	.	1	18	19	1	.	.		trauma, autopsy	306
307.1	1	80.2	0.94	18	0.7	20	1	50.8	55.8	5	173.8	171.1	+	trauma, osteoma, DDD, vOA, pOA, spina bifida occulta atlantis	307.1
307.2	1	81.9	.	.	-0.63	24	2	23	34	3	.	.			307.2
308	1	.	-0.92	13	0.36	14	2	31	35	3	174	.	+	trauma, suppur.arthritis, crib.fem., DDD, vOA, pOA, osteoc.dis.	308
309	1	.	0.93	14	.	.	1	40	48	4	179.6	175.3		trauma, DDD, osteochon.diss., spina bifida occulta sacralis	309
310	1	.	-1.5	12	.	.	2	62	68	6	.	.		osteomyelitis	310
311	2	.	.	.	.	.	.	.	.	.	.	.			311
312.1	1	.	.	.	-1	16	2	23	25	2	149	.			312.1
312.2	2	.	.	.	.	.	.	.	.	.	.	.			312.2
313	1	.	.	.	.	.	3	12	18	1	.	.	+		313
314.1	1	.	-0.84	19	0.71	7	2	24	24	2	157.7	.	+	trauma, DDD	314.1
314.2	1	.	.	.	.	.	3	3	7	0	.	.			314.2
315	1	.	.	.	.	.	3	14	18	1	.	.		cribra orbitalia	315
316	1	.	0.86	14	.	.	1	37	42	.	165.7	166.4		osteoblastoma, Scheuermann's disease, spina bif.occulta sacralis	316
317	1	80	-0.21	14	-1.25	24	2	20	21	2	165.3	.			317
318.1	1	.	.	.	.	.	3	15	18	1	.	.			318.1
318.2	2	.	.	.	.	.	.	.	.	.	.	.			318.2
319	1	.	-1.64	11	-1.24	5	2	51	60	5	168.8	.	+	trauma, cribra femora, osteochondritis dissecans	319
320	1	.	-0.58	12	-1.05	21	2	34	40	3	164	.	+	DDD, vOA, spina bifida occulta atlantis	320
321	2	.	.	.	.	.	.	.	.	.	.	.			321
322	1	.	-1.38	8	-1.2	10	2	30	60	.	.	.		DDD, vOA	322
323.1	1	.	-0.42	12	-1.33	15	2	53.3	59.3	5	166.5	.		metastases, costa bifida	323.1
323.2	1	.	.	.	.	.	3	17	20	1	.	.			323.2
324	1	.	-0.9	10	0.53	15	2	22	28	2	154.4	.			324
325	1	84	-0.87	15	-0.95	19	2	54	60	5	154.8	.		DDD, vOA, subacromial bursitis	325
326	3	.	.	.	.	.	.	.	.	.	.	.			326

Grave Nr.	Status (1)	Cranial index	Pelvis (2)	Pelvis (3)	Cranium (2)	Cranium (3)	SEX (4)	AGE Min. (5)	AGE Max. (6)	Interval (7)	Trotter (cm; '58,'70)	Breitinger (cm; 1937)	Stain (8)	Main paleopathology (9)	Grave Nr.
327	1	.	0.95	19	0.2	15	1	36.5	41.5	3	163.1	164.2		DDD, pOA	327
328	1	.	-0.95	19	-0.72	18	2	20	21	2	153.9	.		facial nerve paralysis, pOA, osteochondritis dissecans	328
329	1	.	0.83	18	.	.	1	51	59	5	161.1	162.9		trauma, rickets, DISH, gout, spina bifida occulta sacralis	329
330	2	.	.	.	.	.	.	.	.	.	.	.			330
331.1	1	.	-1.3	10	-1.56	18	2	21	22	2	164.2	.	+	cribra femora, DDD, osteochondritis dissecans	331.1
331.2	2	.	.	.	.	.	.	.	.	.	.	.			331.2
332	1	.	.	.	.	.	3	11	12	1	.	.		trauma, osteochondroma	332
333	2	.	.	.	.	.	.	.	.	.	.	.			333
334	3	.	.	.	.	.	.	.	.	.	.	.			334
335	1	.	.	.	.	.	3	30	60	.	.	.		DDD	335
336	1	.	-1.8	10	-0.74	23	2	43.3	49.3	4	157.2	.	+	trauma, DDD, vOA	336
337.1	1	.	.	.	.	.	3	3	3	0	.	.			337.1
337.2	1	.	.	.	.	.	3	0.5	0.8	0	.	.			337.2
338	1	.	0.8	10	.	.	1	59.7	65.7	6	171.6	168.9	+	DDD, vOA, pOA, DISH	338
339	1	.	-1.3	10	.	.	2	37	46	.	166.2	.			339
340	1	.	-1.27	11	.	.	2	20.5	24.7	2	.	.		vOA	340
343	1	.	0.6	8	0.88	24	1	47	56	.	152.8	.		trauma	343
344	1	.	1.5	6	.	.	1	40	60	5	.	.		osteoma, DDD, pOA, osteochondritis dissecans	344
345	1	.	1.27	11	.	.	1	50.7	56.7	5	177	173.6		periostitis	345
346	1	.	0.86	14	.	.	1	37	46	3	157.3	161		trauma	346
347	1	.	0.6	5	.	.	1	28	37	.	166.8	166.7			347
348	2	.	.	.	.	.	.	.	.	.	.	.			348
350	2	.	.	.	.	.	.	.	.	.	.	.			350
351.1	1	.	-0.79	14	-1.3	10	2	63.8	69.8	6	155.1	.		trauma, DDD, vOA	351.1
351.2	2	.	.	.	.	.	.	.	.	.	.	.			351.2
352	1	86.3	1	12	0.88	24	1	46.8	51.8	4	173.1	169		trauma, Scheuermann's disease, spina bifida occulta sacralis	352
353	3	.	.	.	.	.	.	.	.	.	.	.			353
354	1	.	.	.	.	.	3	15	20	1	.	.			354
355	1	.	0.94	15	0.62	21	1	40	49	4	167.1	165.1		trauma, DDD, vOA, osteochon.diss., spina bifida occulta sacralis	355

Grave Nr.	Status (1)	Cranial index	Pelvis (2)	Pelvis (3)	Cranium (2)	Cranium (3)	SEX (4)	AGE Min. (5)	AGE Max. (6)	Interval (7)	Trotter (cm; '58,'70)	Breitinger (cm; 1937)	Stain (8)	Main paleopathology (9)	Grave Nr.
356	1	.	1	10	.	.	1	50.7	56.7	5	168.1	167.7		trauma, DDD	356
357	1	.	-0.21	19	0.86	7	2	21	23	2	159.8	.		scoliosis, spina bifida occulta sacralis	357
358	1	79.3	-1	11	-1.13	23	2	63.3	69.3	6	153.1	.		cribra femora, von Bechterew's disease	358
359	1	.	-0.92	12	.	.	2	48	56	.	163.6	.			359
360	1	.	.	.	0.9	21	1	31	32	3	169	168.5		trauma, cribra orbitalia, DDD, vOA	360
361	2	.	.	.	.	.	.	.	.	.	.	.			361
362	2	.	.	.	.	.	.	.	.	.	.	.			362
363	1	.	0.75	12	.	.	1	40	60	.	165.7	165.9		DDD	363
364	1	.	1.58	12	.	.	1	34	43	3	167.4	167.9		trauma, Scheuermann's dis., osteochon.diss., Calvé-Perthes dis.	364
365	1	.	1.17	12	.	.	1	40	60	.	.	.	+	DISH	365
366.1	1	.	-0.64	11	-1	7	2	21	24	2	.	.		cribra femora, spina bifida occulta sacralis	366.1
366.2	1	.	1.3	10	.	.	1	65	70	6	181.2	178.5		DISH	366.2
367	1	.	-0.73	11	.	.	2	.	.	.	165.5	.	+	periostitis, pOA	367
368	1	.	-1.46	13	-0.82	17	2	21	22	2	156.1	.	+	vOA, scoliosis	368
369	3	.	.	.	.	.	.	.	.	.	.	.			369
370	1	.	.	.	1.25	20	1	44	53	4	.	.		DDD, pOA	370
371	1	.	.	.	0.8	10	1	54.3	60.3	5	169.4	167.4	+	trauma, DDD, vOA, pOA, osteochon.diss., autopsy, scoliosis	371
372	1	79	.	.	1	24	1	52	55.7	5	173.3	172.5		trauma, DDD	372
373	1	.	.	.	0.86	21	1	40	42	4	.	.		DDD	373
374	1	.	.	.	-0.69	13	2	18	22	2	.	.		trauma, DDD	374
375	1	.	.	.	.	.	3	40	60	.	154.5	.			375
376	2	.	.	.	.	.	.	.	.	.	.	.			376
377	1	.	.	.	.	.	3	11	11	1	.	.		rickets	377
378	1	.	-0.89	19	-1.15	20	2	19	25	2	153.4	.	+	vOA	378
379	2	.	.	.	.	.	.	.	.	.	.	.			379
380	1	.	-1.2	10	.	.	2	50	80	.	.	.		osteomyelitis	380
381	1	.	.	.	.	.	3	35	55	.	163.7	.			381
382	2	.	.	.	.	.	.	.	.	.	.	.	.		382
383	1	.	-1	8	-0.83	18	2	25	34	3	.	.	+	cribra femora	383

Grave Nr.	Status (1)	Cranial index	Pelvis (2)	Pelvis (3)	Cranium (2)	Cranium (3)	SEX (4)	AGE Min. (5)	AGE Max. (6)	Interval (7)	Trotter (cm; '58,'70)	Breitinger (cm; 1937)	Stain (8)	Main paleopathology (9)	Grave Nr.
384	1	82.2	.	.	-0.57	23	2	40	80	7	.	.	+		384
385	1	.	-0.92	13	.	.	2	35	55	.	.	.	+	trauma, cribra femora	385
386	1	.	.	.	0.61	23	1	38	42	3	177.3	173.1	+	DDD	386
387	1	.	0.83	12	.	.	1	40	70	.	162.2	162.3		DDD	387
388	1	.	.	.	-0.55	20	2	34	50	.	175.6	.		vOA	388
389	1	.	.	.	.	.	3	34	43	.	164.5	.			389
390	1	.	-1	13	.	.	2	55	63	.	173.6	.		cribra femora, DDD, pOA, spina bifida occulta sacralis	390
391	2	.	.	.	.	.	.	.	.	.	.	.			391
392	1	.	-1.6	10	-1	15	2	47	63	4	159	.		hyperostosis frontalis interna	392
395	1	.	0.17	12	.	.	1	25	34	3	164.7	165.7		DDD, vOA, scoliosis, spina bifida occulta sacralis	395
396	2	.	.	.	.	.	.	.	.	.	.	.			396
397	2	.	.	.	.	.	.	.	.	.	.	.			397
398	1	.	.	.	.	.	3	-0.4	-0.4	-1	.	.	+		398
399	1	84.4	0.82	17	1.04	23	1	28.7	34.7	3	162.5	162.9			399
400	3	.	.	.	.	.	.	.	.	.	.	.			400
401	1	.	.	.	.	.	3	30	60	.	160.8	.		trauma	401
402	3	.	.	.	.	.	.	.	.	.	.	.			402
404	1	.	.	.	.	.	3	4	4	0	.	.		spina bifida occulta sacralis	404
405	3	.	.	.	.	.	.	.	.	.	.	.			405
406	1	.	.	.	.	.	3	2	3	0	.	.			406
407	1	.	.	.	.	.	3	4	5	0	.	.			407
408	1	.	-1.14	14	-1.1	10	2	52.3	58.3	5	152.4	.		trauma, DDD, vOA, pOA	408
409	3	.	.	.	.	.	.	.	.	.	.	.			409
410	1	.	.	.	.	.	3	4	5	0	.	.		rickets	410
411	1	.	1.2	10	.	.	1	59	68	6	172.8	171.3		trauma, osteoblastoma, DDD, pOA	411
412	1	79.8	-1.38	8	-0.87	23	2	43	50	4	147.5	.		pOA	412
413	1	79.2	.	.	-0.78	23	2	40	80	6	.	.		osteoma	413
414	1	.	.	.	-1.13	16	2	34	34	3	.	.		cribra orbitalia	414
415	3	.	.	.	.	.	.	.	.	.	.	.			415

Grave Nr	Status (1)	Cranial index	Pelvis (2)	Pelvis (3)	Cranium (2)	Cranium (3)	SEX (4)	AGE Min. (5)	AGE Max. (6)	Interval (7)	Trotter (cm; '58,'70)	Breitinger (cm; 1937)	Stain (8)	Main paleopathology (9)	Grave Nr.
416.1	1	86	.	.	1	23	1	34	40	3	.	.		periostitis	416.1
416.2	1	.	.	.	.	.	3	16	20	1	.	.		dwarfism	416.2
417	1	80	.	.	0.74	23	1	47	63	6	172.1	171.5			417
418	1	.	0.82	11	0.7	20	1	53	62	.	.	.		osteomyelitis, rickets, osteochondroma, pOA	418
419	1	.	-1	10	.	.	2	50	70	.	.	.		pOA	419
420	1	.	-0.9	10	.	.	2	.	.	.	160.8	.		pOA	420
421	1	.	-1.14	14	-1.17	6	2	43.3	49.3	4	153.4	.		DDD, pOA	421

MAIN DEMOGRAPHIC DATA PER INDIVIDUAL (CA 1450 AD)
(from 8 individually distinct, but incomplete, skeletons)

258	1	.	0.82	11	1	5	1	51.3	57.3	5	174.9	172.8		trauma, pOA	258
261	2	.	.	.	.	.	.	.	.	.	.	.			261
341	1	.	1.11	19	.	.	1	46	52	4	178.7	175.4		trauma, DDD, vOA, pOA, osteochondritis dissecans	341
342	1	79.2	1.08	12	0.38	24	1	34	35	3	.	.	+	sinusitis	342
349	1	.	-1	6	.	.	2	20	40	.	.	.			349
393	1	.	1	8	.	.	1	25	25	2	.	.	+	periostitis, amputation	393
394	1	.	1.2	10	1.53	19	1	34	34	3	.	.	+	multiple myeloma, DDD	394
403	1	80.2	-0.63	8	-0.95	20	2	40	80	.	.	.		trauma, sinusitis, DDD, vOA, pOA	403

1: 1 = skeleton, 2 = commingled bones, 3 = no bones
2: Degree of sexualization
3: Weight of sex indicators
4: 1 = male, 2 = female, 3 = unknown
5: Minimum age (years)
6: Maximum age (years)
7: e.g. 5 = 5.0-5.9 years
8: + = copper stain on skeleton

9: DDD = degenerative disc disease
vOA = vertebral osteoarthritis
pOA = peripheral osteoarthritis
DISH = diffuse idiopathic skeletal hyperostosis
osteochon.diss.= osteochondritis dissecans

Table 3. **MAIN DEMOGRAPHIC DATA (1830-1858 AD)**

		N
Number of individually distinct skeletons		316
Number of graves with commingled remains		72
Number of graves without remains		60
Horizontal cranial index, overall (mesocranic)	78.8	42
Percentage of adult males	52%	123
Percentage of adult females	48%	114
Adults of unknown sex		73
Percentage of individuals under 20 years	29.7%	68
Percentage of individuals over 20 years	70.3%	161
Individuals of unknown age		81
Mean age at death of population over 20 years	42.2 years	161
Idem, for males	43.4 years	83
Idem, for females	41.4 years	74
Stature of adult males (Breitinger 1937)	169.6 cm	82
Stature of adult females (Trotter & Gleser 1958)	160.5 cm	84
Mean maximum femoral length of adult males	45.7 cm	67
Mean maximum femoral length of adult females	42.8 cm	53

N= number of individuals inspected

Tabel 4. **TOTAL COUNT OF TEETH FROM ADULTS**
(individually distinct, but incomplete, skeletons)

	Mean per individual (s.d.)	Total number of teeth inspected	Number of individuals inspected
N erup	31.51 (1.0)	4128	131
N ret	0.44 (0.9)	58	131
N supernumery	0.0 (0.0)	1	131
AM loss	4.03 (6.6)	528	131
PM loss	3.80 (3.8)	498	131
N insp	16.61 (9.8)	2176	131
PM miss.pos	7.08 (7.9)	927	131
N car	3.43 (3.1)	449	131
N absc	1.21 (1.7)	159	131
N fis	1.18 (1.7)	155	131

s.d. = standard deviation.

Tabel 5. **DENTAL STATUS IN PERCENTAGES**
(individually distinct, but incomplete, skeletons)

	Percentage	Number of individuals inspected
Antemortem loss	16.5 %	131
Postmortem loss	18.6 %	131
Caries frequency	20.7 %	131
Abscess frequency	5.9 %	131
DM(F) Index	36.2%	131

DM(F) = decayed, missing, (filled)

Table 6. **MAIN PATHOLOGICAL CHANGES IN BONES**
(316 individually distinct, but incomplete, skeletons)

Pathology		N affected	N inspected
MECHANICAL TRAUMAS			
Healed fractures (spines excluded)		65 (20%)	316
Individuals with multiple fractures (spines excluded)		9	NA
Skull wounds		3 (2%)	148
Pubic parturition scars		2	NA
INFECTIONS:			
Periostitis, tibia, hematogenous		13 (11%)	121
Periostitis, tibia, traumatological		3 (2%)	121
Osteomyelitis, hamatogenous		11	NA
Tuberculosis, spinal		1 (<1%)	160*
Pleuritis, aspecific		1	NA
Suppurative arthritis		3	NA
Meningitis		1 (<1%)	148
Sinusitis		3	NA
DEFICIENCY DISEASES			
Rickets, tibias,	non-adults	3 (4%)	68
	adults	8 (7%)	121
Cribra orbitalia,	non-adults	5 (16%)	32
	adults	6 (6%)	105
Cribra femora,	non-adults	12 (30%)	40
	adults	41 (23%)	175
Osteoporosis,	general	3	NA
TUMORS			
Osteoma,	cranial	5	NA
	tibial	3	NA
Osteochondroma,	tibia	4 (2%)	121
	femur	1 (<1%)	168
	metacarpal	1	NA
Osteoblastoma		2	NA
Multiple myeloma		1 (<1%)	148
Metastases, cranial		1 (<1%)	148

N = number of individuals
NA = Not Applicable.
* = most vertebras present

Table 7. MAIN PATHOLOGICAL CHANGES IN JOINTS
(316 individually distinct, but incomplete, skeletons)

Pathology	N affected	N inspected
ARTHROPATHIES		
Degenerative disc disease (DDD)	99 (59%)	169*
Vertebral osteoarthritis (vOA)	60 (36%)	169*
Peripheral osteoarthritis, (pOA), overall	60	NA
Peripheral osteoarthritis (pOA), hip	39 (28%)	140
Peripheral osteoarthritis (pOA), knee	9 (8%)	116
Peripheral osteoarthritis (pOA), temporo-mand.	3 (2%)	148
Bursitis, subacromial	1	NA
DISH	21 (11%)	190**
Scheuermann's disease	5 (3%)	174**
Gout	7	NA
Osteochondritis dissecans	20	NA
SERONEGATIVE ARTHROPATHIES		
von Bechterew's disease	2 (1%)	171**
Reiter's syndrome	3 (2%)	172**
Psoriatic arthritis	0	169**

N = number of individuals
NA = Not Applicable.
* - all three spinal levels inspected, but
- cases complicated by other arthropathies excluded.
** - idem but, except for DDD and vOA, cases complicated by other arthropathies excluded.

Table 8. MISCELLANEOUS PATHOLOGICAL CHANGES
(316 individually distinct, but incomplete, skeletons)

Pathology	N affected	N inspected
Paget's disease	1	NA
Dwarfism e.c.i.	1	316
Hyperostosis frontalis interna	1 (<1%)	148
Atlanto-occipital fusion	2 (1%)	148
Basilar impression	1 (<1%)	148
Facial nerve paralysis	1	NA
Dental wear channels , 25/57 males, 6/51 females	31 (28%)	109
Calvé-Perthes (avascular necrosis)	2 (1%)	168
Allen's fossa	54 (32%)	168
Allen's fossa and cribra femora	10 (19%)	54
Poirier's facet	12 (7%)	168
Costo-clavicular articulation	1	NA
Autopsies : individually distinct skeletons	8	NA
commingled remains	4	NA

N = number of individuals
NA = Not Applicable
e.c.i. = e causa ignota / cause unknown.

Table 9. FEQUENCY OF ANOMALIES IN ADULTS
(316 individually distinct, but incomplete, skeletons)

Pathology	N affected	N inspected
Microcephaly	1 (<1%)	148
Metopism	13 (9%)	148
Os Japonicum	1 (<1%)	148
Os lambdoideum	2 (1%)	148
Inca bone	2 (1%)	148
Occipital torus	1 (<1%)	148
Scoliosis e.c.i.	11 (7%)	160
Fusion of vertebral arch Th3-4	1	NA
Costa bifida	2	NA
Spina bifida occulta:		
atlas	5 (6%)	82
Th1	1	NA
L5	1	NA
Sacral, complete	3	130
Sacral, incomplete	33 (25%)	130
Sacralisation L5	19	NA
Lumbarization S1	3	NA
Sternal foramen	1	NA
Foramen olecrani	4 (3%)	124
Supratrochear spur	1 (<1%)	124

e.c.i. = e causa ignota / cause unknown.
NA = Not Applicable.
L = lumbar vertebra
Th = thoracic vertebra
S = sacral vertebra

Table 10. FREQUENCY OF HEALED FRACTURES IN ADULTS
(316 individually distinct, but incomplete, skeletons)

Fractured bone	N affected	N inspected
Vault, impression	1 (<1%)	148
Frontal bone	1 (<1%)	148
Vertebra, endplate avulsions	35 (22%)	160*
complete body compression	8 (5%)	160*
other (dorsal spines, facets, etc)	9	NA
Spondylolysis	9 (6%)	160
Ribs	8	NA
Clavicle	8 (4-5%)	95/96**
Scapula	2	NA
Humerus	4 (2%)	119/124**
Radius, only	7 (3%)	107/116**
Ulna, only	6 (1-4%)	113/123**
Radius and ulna	4 (1-3%)	107/116**
Forearm, overall	17 (14-16%)	107/123**
Carpals and phalanx	3	NA
Metacarpal	1	NA
Femur	4 (1%)	167/168**
Patella	1	NA
Tibia	2 (0-2%)	112/121**
Fibula	2 (0-2%)	85/88**
Calcaneus	1	NA
Metatarsal	3	NA

N = number of individuals
NA = Not Applicable.
* = spines with most vertebra present.
** = number of that specific bone inspected Left/Right.

Table 11. AVERAGE AGE AT DEATH (YEARS)
(deceased older than 20 years of age)

Period and Cemetery	Overall	Males	Females	N
Delft (1265-1433)[1]	45	43	47	52
Dordrecht (1275-1572)[2]	44.1	45.0	43.3	199
Delft (1433-1652)[1]	46	43	49	49
Gorinchem (1455-1572)[3]	52.1	53.3	50.6	21
Breda (1600-1824)[3]	49.7	47.8	51.8	38
Zwolle (1725-1828)[4]	50	?	?	?
Alkmaar (1725-1828)[5]	?	60	56	188
's-Hertogenbosch (1830-1858)[6]	42.2	43.4	41.4	161

N = number of individuals inspected
[1] Onisto et al., 1998
[2] Maat et al., 1998
[3] Maat and Mastwijk, 2000
[4] Aten, 1992
[5] Beatsen, 2001
[6] This study

Table 12. AVERAGE STATURE OF MALES IN THE NETHERLANDS
(calculated, in situ measurement*, corrected cadaveric length**, live)

Cemetery	Period AD	Population	Length (cm)	s.d.	N	Means
Valkenburg [1]	50- 225	native	175.9	6.2	10	Trotter & Gleser, 1958
Maastricht [2]	1070-1521	Canons	173.9	3.9	23	Breitinger, 1937
Delft [3]	1265-1433	citizens	170.5	4.6	25	Breitinger, 1937
Dordrecht [4]	1275-1572	citizens	170.6	3.8	80	Breitinger, 1937
Delft [3]	1433-1652	citizens	168.9	3.4	19	Breitinger, 1937
Gorinchem [5]	1455-1572	citizens	169.7	3.8	11	Breitinger, 1937
Breda [5]	1600-1824	citizens	171.3	4.4	19	Breitinger, 1937
Spitsbergen [6]	1642-1800	whalers	166.0	6.9	41	in situ measurement
Leiden [6]	1650-1800	citizens	166.7***	9.3	102	in situ measurement
Zwolle [7]	1725-1828	citizens	172.9	.	33	Trotter & Gleser, 1958
Alkmaar [8]	1725-1828	citizens	170.0	.	70	Breitinger, 1937
Seven cities [9]	1825	militia	169.0	.	382	Live
's-Hertogenbosch [10]	1830-1858	citizens	169.6	4.4	82	Breitinger, 1937
Seven cities [9]	1865	militia	167.5	.	722	Live
Leiden [9]	1880-1930	citizens	166.0	7.9	86	cadaveric measurement
Nationwide [11]	1955	citizens	175.5	6.7	1213	Live
Nationwide [12]	1975	conscripts	178.0	.	391	Live
Nationwide [13]	1980	conscripts	182.0	.	3233	Live
Nationwide [14]	1997	civilians	184.0	.	900	Live

N = number of individuals inspected
s.d. = standard deviation (cm)
* missing skin was compensated for by postmortem stretch (Maat, 1993)
** compensated 2 cm for postmortem stretch (Maat, 1993, 2001)
*** deduced from 102 males and females
[1] Lonnée and Maat, 1998
[2] Janssen and Maat, 1999
[3] Onisto et al., 1998
[4] Maat et al., 1998
[5] Maat and Mastwijk, 2000
[6] Maat, 1984
7 Aten, 1992
[8] Beatsen, 2001
[9] Oppers, 1966
[10] This study
[11] de Wijn and Haas, 1960
[12] van Wieringen et al., 1971
[13] Roede et al., 1985
[14] Fredriks, 2000

Table 13. AVERAGE MAXIMUM FEMORAL LENGTH OF MALES IN THE NETHERLANDS

Cemetery and Period AD	Population	Length (mm)	s.d. (mm)	N
Valkenburg (50-225) [1]	native	50.3	1.5	3
Maastricht (1070-1521) [2]	Canons	48.7	2.0	17
Delft (1265-1433) [3]	citizens	46.0	2.6	20
Dordrecht (1275-1572) [4]	citizens	46.2	2.5	59
Delft (1433-1652) [3]	citizens	45.5	1.9	16
Gorinchem (1455-1572) [5]	citizens	45.7	2.6	11
Breda (1600-1824) [5]	citizens	47.5	2.6	14
Spitsbergen (1642-1800) [6]	whalers	47.1	3.0	38
Leiden (1650-1800) [6]	citizens	46.3	2.3	12
's-Hertogenbosch (1830-1858) [7]	citizens	45.7	2.5	67
Leiden (1947-1970) [7]	citizens	45.9	2.7	100

N = number of individuals inspected
s.d. = standard deviation
[1] Lonnée and Maat, 1998
[2] Janssen and Maat, 1999
[3] Onisto et al., 1998
[4] Maat et al., 1998
[5] Maat and Mastwijk, 2000
[6] Maat, 1984
[7] This study

Table 14. CARIES RELATED CHANGES IN THE NETHERLANDS

Cemetery and Period AD	Population	AM loss (%)	Caries frequency (%)	DM(F) Index (%)
Valkenburg (50-225) [1]	native	3.6	6.5	.
Maastricht (1070-1521) [2]	Canons	11.0	17.0	31.0
Delft (1265-1433) [3]	citizens	16.2	7.6	22.5
Dordrecht (1275-1572) [4]	citizens	12.0	12.0	26
Delft (1433-1652) [3]	citizens	19.1	12.3	30.1
Spitsbergen (1642-1800) [6]	whalers	6.8	13.4	19.3
Alkmaar (1725-1828) [7]	citizens	.	12.2	.
's-Hertogenbosch (1830-1858) [8]	citizens	16.5	20.7	36.2

AM = antemortem
DM(F) = decayed, missing, filled
[1] Lonnée and Maat, 1998
[2] Janssen and Maat, 1999
[3] Onisto et al., 1998
[4] Maat et al., 1998
[5] Maat and Mastwijk, 2000
[6] Maat, 1987
[7] Beatsen, 2001
[8] This study

OTHER VOLUMES OF THE SERIES "BARGE'S ANTHROPOLOGICA"

Janssen, H.A.M. and G.J.R. Maat
Kanunniken begraven in de Stiftskapel van de Sint Servaas te Maastricht, 1070-1521 na Chr. Een paleopathologisch onderzoek. Leiden, Barge's Anthropologica 1: 1-40, 1998.

Onisto, N., Maat, G.J.R. and E.J. Bult
Human remains from the infirmary "Oude en Nieuwe gasthuis" of the City of Delft in The Netherlands 1265-1652 AD. Leiden, Barge's Anthropologica 2: 1-43, 1998.

Lonnée, H.A. and G.J.R. Maat
Inhumations in a Roman cemetery at Valkenburg-Marktveld (Zuid-Holland) in The Netherlands. Leiden, Barge's Anthropologica 3: 1-50, 1998.

Maat, G.J.R. and J.-J. Verlaan
The search for Willem Barentsz. Report on the International Nova Zembla Expedition 1998. Leiden, Barge's Anthropology 4: 1-22, 1998.

Maat, G.J.R. and J.-J. Verlaan
The search for Willem Barentsz. Report on the International Nova Zembla Expedition 1998. Second edition. Leiden, Barge's Anthropologica 4: 1-22, 2001.

Janssen, H.A.M. and G.J.R. Maat
Canons buried in the "Stiftskapel" of the Saint Servaas Basilica at Maastricht, 1070-1521 AD. A paleopathological study. Leiden, Barge's Anthropologica 5: 1-40, 1999.

Maat, G.J.R., Panhuysen, R.G.A.M. and R.W. Mastwijk
Manual for the Physical Anthropological Report. Leiden, Barge's Anthropologica 6: 1-50, 1999.

Maat, G.J.R., Panhuysen, R.G.A.M. and R.W. Mastwijk
Manual for the Physical Anthropological Report. Second edition. Leiden, Barge's Anthropologica 6: 1-50, 2000.

Maat, G.J.R., Van den Bos, R.P.M. and M.J. Aarents
Manual for the preparation of ground sections for the microscopy of bone tissue. Leiden, Barge's Anthropologica 7: 1-18, 2000.