Mortuary customs in prehistoric Malta

Excavations at the Brochtorff Circle at Xagħra (1987–94)

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Chapter 11

The Human and Animal Remains

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11.1. The human bone

11.1. 1. Introduction

This sample of nearly 220,000 human bones from the Circle is large by any standard, and especially for a Neolithic site. The first excavations of Ħal Saflieni, the only other known comparable site on Malta, failed to record any human bone, even though much was found. The second excavations of Ħal Saflieni have concentrated more on the structure of the entrance (Pace 2000). Other excavations in Malta have only recovered small samples (Pike 1971b). The Circle sample is, therefore, difficult to compare, although this will be attempted both here and in Chapter 14. Detailed population studies remain elusive in spite of the large number of remains, given its disarticulated nature. The primary aim therefore, has been to analyse how parts of the body were redistributed across the site, and assess the various dimensions of the population, in so far as a mixed collective funerary ritual allows.

As outlined in Chapter 5, excavation methods employed on bone-rich deposits were generally organized in measured metric squares within the site grid, subdividing the visible natural stratigraphy into spits, taking a plotted record for each spit on 1:10 drawings. The record thus made has enabled each bone to be identified provisionally *in situ*, drawn and later re-identified to its exact position and group association.

The human bones were identified to element, side and part of element by a team which included Caroline Barker, Gary Burgess, Andrew Clarke, Corinne Duhig, George Mann and Cristina Sampedro, and recorded systematically on standardized recording forms.[1] George Mann was particularly responsible for the identification of pathology. Where fragmentation was too great to allow this, recording was to a lower level of identification (e.g. long-bone fragments or cranium fragments). Loose teeth were recorded to mandibular and maxillary tooth type. Dental attrition was recorded on a separate form identifying portions of mandible and maxilla. Two types of recording form were used: the first for skeletal parts identified directly on site, the second for general material. Articulated individuals and skulls were recorded on separate forms.

Age was recorded according to the following criteria. Subadult material (articulated and disarticulated) was aged by dental eruption and development (Ubelaker 1984), degree of epiphyseal union (Bass 1987), and long-bone size (Ubelaker 1989). As the majority of the subadult long bones were fragmented, lengths could often not be measured. In these cases, the following age categories were assigned: *In utero*, Neonatal, Infant (0–1 year), Young Child (1–8 years), Old Child (8–14 years) and Adolescent/Subadult (14–18 years). In some cases children could not be subdivided, and in other cases, Adolescent/Subadult could be subdivided (App. 9.3). Adult material was even more difficult to age because of the lack of articulation and fragmentary nature of the skeletal material. Where present, the articular surface of the pubic symphysis was employed to divide adults into Young Adult, Mid Adult and Old Adult individuals (Brooks & Suchey 1990; Gilbert & McKern 1973). Very few pubic symphyses were available for analysis.

Sex was assigned, where possible, employing any elements with sexable features to the following categories: possible male (M??), probable male (M?), definite male (M), indeterminate (?), possible female (F??), probable female (F?), definite female (F), and the relevant features recorded (e.g. sciatic notch f?, ventral arc f). In the majority of cases, and not just those of juveniles, individual bones had no sexing information.

Metrics were recorded employing all the measurements (where available) suggested by Bass (1987), although only the maximum length and breadth of the skull have been recorded here.

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1. These records are held in an Archive of Heritage Malta and a digital archive has been prepared for wider distribution.

All these data were entered into an Access data base (developed by David Redhouse) and integrated with other contextual information. The material was then sorted within each context by Age, Side, and within the Aged/Unaged categories, sorted by skeletal part and fragment of skeletal part (grouped by regions of the body), taking into account analysts' notes, to assess as accurately as possible the MNI for each age group and each body part, along broadly common ground in this very diverse series of deposits. For some small, and in this deposit, robust bones (e.g. patella) this identification was a relatively simple and uncontroversial procedure. In the case of more easily fragmented bones (e.g skull), relatively robust and identifiable sided components (e.g. petrous) were examined in turn to provide a conservative count of MNI; to take another example, in the case of long bones, complete articular ends were subjected to the same analysis. Care was taken not to inflate the MNI of skulls (which have the highest figure in context-based analysis see below), through identification of recognizable sided skull components without double counting within each context. However, there may be some inflation from small deposits where the ready identification of skulls to 1 MNI may compare with only a long-bone identification from a deposit of comparable fragmentation. In the context of the large sample size, the differential visibility of age in body parts, and the overall objective to understand how buried individuals were redistributed around the site, it was decided that an overall comparison of MNI would give the best comparative understanding of the relative presence of age and body part. The percentage of the 'expected presence' technique would have covered part of this pattern, but not allowed comparison of disarticulated aged and sexed bones where information on age and sex is disproportionately concentrated in some body parts. A similar procedure was thus applied to the assessment of age and sex to produce estimates of MNI for each context (mainly on skull). Testing of the differential presence of sides of the body did not produce any clear-cut results. In the text for the larger deposits, a low-level MNI is given based on total unaged body parts, and a higher level MNI based on the sum of MNIs of aged and unaged body parts (this latter figure probably contains double accounting given the potential overlap of age categories).

A further analysis has tried to establish fragmentation indices for each deposit. One simple measure is the proportion of unidentified material. Another measure is calculated from the relationship between identified fragments and Minimum Numbers; the measure finally employed was FI = NISP/MNI, where the NISP was the number of fragments identified to body part and MNI the minimum number of individuals calculated from the cumulative maximum number from sided body parts (aged and unaged). This is a complicated index to employ since it is sensitive to sample size and to the varying relationship between degree of fragmentation and effects on NISP and MNI. The first stages of fragmentation will depress MNI and increase NISP, leading to higher values of the index. The later stages will continue to depress MNI, but also depress NISP (Marshall & Pilgram 1993). Thus we need to make the assumption that deposits are in the earlier stages of fragmentation where higher values of the index indicate higher fragmentation, a situation, we believe, holds in the Circle deposit. A further complication is that the index has been calculated inclusive of age leading to a potential depression of the index's value when many aged MNIs are present. For these reasons, the FI is used sparingly in the text and only for large sample sizes. Detailed summaries of the human bone data are to be found in Appendices 9.1–9.3.
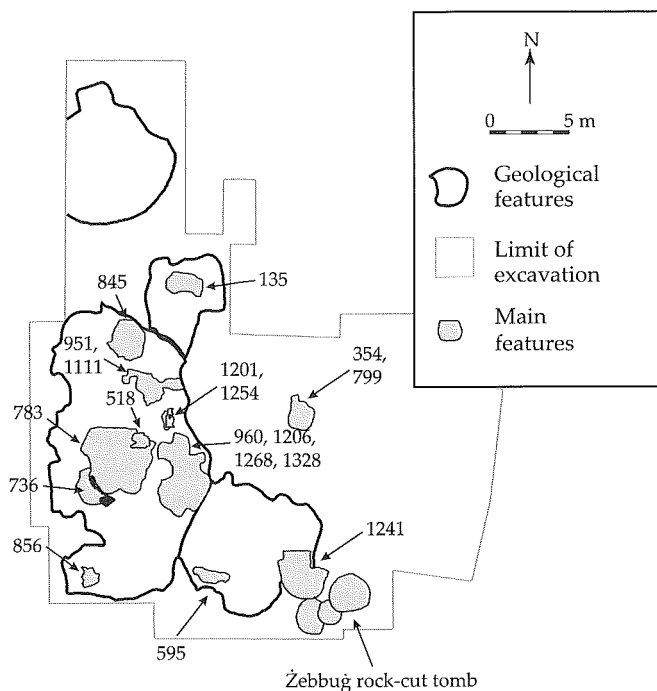
A slightly different procedure was adopted for the already published sealed Żebbuġ rock-cut tomb, and is explained in more detail below.

The arrangement of human remains has already been discussed within the spatial and stratigraphic section of this volume (Chapters 7 & 8), although osteological details of the most significant intact individuals are further described below. Further evidence of 182 recognizable but incomplete individuals was detected but considered too fragmentary to be reported in detail here and scholars are referred to the project archive in the National Museum of Malta.

Refitting of body parts back to their contributing individuals is a methodology often practised on sites with a small MNI (e.g. Saville 1990), but has not yet been attempted here for reasons of time and expense beyond the scope of the present project. Clearly there are many opportunities for developing such work, perhaps in conjunction with selective DNA, isotopic, chronometric and other studies. A small-scale study is already under way to investigate further analysis of this unique and challenging deposit.

11.1.2. The nature of the deposit (Fig. 11.1)

The essential nature of the deposit is that complete articulation is rare. The only comprehensive way of analysing the deposit is as a series of disarticulated fragments arranged spatially across the site. The key analysis, therefore, relates to access to the burial rite and treatment through the burial rite, rather than a detailed insight into demography or health, although very broad statements can be made about these issues. The recovered bone comprises 216,587 fragments of human bone of which

Figure 11.1. *Location of major human-bone deposits in the Circle.*

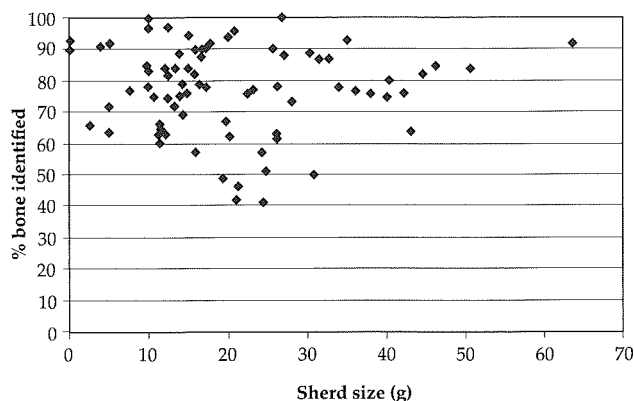
Figure 11.2. *Fragmentation of pottery and bone. Comparison of pottery sherd size and bone fragmentation index.*

Figure 11.3. *Fragmentation of pottery and bone. Comparison of pottery sherd size and % recognition of human bone.*

40,540 fragments (18.7 per cent) could not be identified to body part. The vast majority of this fragmentary material, 190,774 fragments (88 per cent) (of which 36,788 or 19.28 per cent could not be identified), came from stratified Tarxien deposits, although it cannot in some cases be excluded (e.g. context 595) that some Tarxien deposits contain residual Żebbuġ phase material. A substantial proportion of the remainder, 10,967 fragments (5 per cent), of the deposit was Żebbuġ in date, mainly derived from the twin-chambered tomb which has already been published in detail (Malone *et al.* 1995a).

Issues of taphonomy are fundamental in any consideration of the burial deposit. In spite of the considerable disarticulation of the deposits, the human remains were remarkably well preserved. If there was a profound attrition of some deposits compared with others, it might be expected that pottery and bone would suffer a similar rate of attrition in any given deposit (although it is granted that bone may be more sensitive to degradation). To study this, two simple explorations were implemented. The first was a comparison of the pottery fragmentation rate, measured by average sherd weight (see Chapter 6) with the human bone fragmentation rate (calculated according to the principle explained above). A scattergram of this relationship shows only a very slight trend linking the increased fragmentation of bone to the decreased fragmentation of pottery and many outliers from this trend (Fig. 11.2).

The second was a comparison of pottery fragmentation rate, measured by average sherd weight with the proportion of identified bones. A scattergram of this relationship showed no linkage at all (Fig. 11.3). Our conclusion from this simple analysis is that the dominant cause of patterning is that of human action rather than a severe consequence of natural action. During the excavation, it was noted that the site could become severely affected by inundation and temporary pooling of water in unprotected areas, leading possibly to the movement of surface material. However, given the calcareous deposits of the site these effects were temporary, because drainage was relatively rapid, leaving traces of silt lenses that were also detected in the archaeological deposits. Visual inspection of the human bone showed no evident effects of leaching and inundation.

Another attempt to address the taphonomy of the site was an explicit attention to body parts. Although there does not appear to have been any clear separation of sides of the body in the packaging of burial

deposits, there does appear to have been some very marked differential placing of specific body parts which is explored in more detail in the Tarxien section below.

11.1.3. Żebbuġ: the sealed chamber tomb

The Żebbuġ rock-cut tomb skeletal material in the published chambered tomb (Malone *et al.* 1995a) was, with the exception of a Ġgantija phase insertion, a tight, sealed chronological group. Although the earliest material from the Circle, its condition was generally similar to that found in the first few seasons of excavation elsewhere on the site in the more exposed levels. Few complete bones remain, due to crushing exacerbated by fragility, the fragments generally being light and friable as a consequence of loss of collagen, unsurprising, given the free-draining nature of the Gozitan limestone (Goffer 1980). No bones were washed — the need for close examination of their surfaces had to be sacrificed to preservation. Nor was the limestone concretion which covered some of the bones removed, and some specimens required consolidation. Red ochre, present in both tomb chambers, had stained many bones and persisted as a fine, penetrating dust.

11.1.4. Methods for the analysis of the Żebbuġ chambered tomb (CD)

General techniques used are taken from Steele & Bramblett (1988) and Ubelaker (1989), and methods for handling bone in quantity from animal bone analysis (e.g. Klein & Cruz-Uribe 1984). Identifiable fragments were recorded by bone, part and side, or, if precision were impossible, by area of skeleton or fragment type. Unidentifiable fragments were counted. Features indicating age or sex were noted, but the bone condition made this rare; ageing and sexing are, in any case, problematical for disordered material, since few features have high accuracy when used independently. Even the ageing of immature individuals by tooth development and eruption, and epiphyseal fusion, fails for material in this condition. It was found difficult to apply the Brothwell (1972) method of ageing by tooth attrition, owing to the unusually slight wear in this population, discussed below. Brothwell's categories are, therefore, given as ranges: 'young', 'mature', 'older' and 'aged' adults.

Within each chamber, minimum numbers of individuals (MNIs) were determined for adults and immatures. Inventories adapted from Waldron's (1987) work were compiled for each chamber, to tabulate representation of body parts and calculated independently for the west and east chambers. A Fragmentation Index (FI) (Klein & Cruz-Uribe 1984) has been calculated for each chamber to assess post-mortem disturbance.

11.1.5. Results

In all, the remains of 54 adults and 11 children have been identified in the tomb, but disarticulation and fragmentation is such that these figures must be seen as minima. Although the negligible amount of data on age and sex prevents demographic analysis, it can be said that males and females, adults and children of a range of ages were found.

Some individual bones and some units (the excavator's perceived discrete groups of bones) crossed between contexts; this is discussed below.

11.1.5.1. West chamber

From nearly 7000 fragments of bone found here, a MNI of 34 adults has been determined. Only 40 per cent of the bones were precisely identifiable and average survival of these was less than 40 per cent, but completely unidentifiable fragments are only 7 per cent of the total. The Fragmentation Index is 196. Eight persons could be sexed, five males and three females; one of the males was between 22 and 43 years. One of the females, a mature adult, is represented by the only complete skull in this chamber.

Between seven and fourteen immature individuals were identified. Of these, at least three and possibly eight, were adolescents, two or possibly three were in later childhood (5–12 years), and one each in earlier childhood and infancy. As might be expected, bone preservation improves with increasing age, suggesting that immature skeletons are under-represented because of their fragility rather than because infants and children were buried elsewhere. On the other hand, the apparent good health of the population (see below) may be such that infant/juvenile mortality was genuinely low.

The number of bones with any sign of disease was exceptionally small (17: 0.6 per cent of those precisely identifiable), even given the deficiencies of the material. Most are degenerative arthritic changes of age. Of particular interest is the low occurrence of cribra orbitalia, an indicator of iron-deficiency anaemia (Stuart-Macadam 1982), present in only one specimen. Dental enamel hypoplasia, another indicator of childhood environmental stress, whether starvation or febrile illness (e.g. Goodman & Capasso 1992), is also uncommon, scarcer, indeed, than in modern rural communities (J. Bowman pers. comm.). Overall, this appears to have been a very healthy population, or rather a population which died by means that left little trace in the osteology. They were exceptional in dental health also, in that carious teeth were fewer (2.3 per cent) than any recorded by Brothwell for prehistoric Europe, despite calculus and alveolar recession, signs of poor dental hygiene. Some unusual patterns of tooth wear might be parafunctional.

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11.1.5.2. East chamber

This chamber contained only half as many fragments as the west chamber; although preservation was better, fragmentation was less (FI = 177) and unidentifiable bones only 3 per cent of the total. The number of articulated skeletal elements was greater, and fewer bones crossed between contexts. The recovery pattern is similar between chambers and the axial skeleton has suffered most. The MNI in this chamber was 20 adults, with two males and two females identifiable, one female being 18–25 years old, (one male is described below). Only two adolescents were found and two children, and, as many of their bone fragments were associated, these numbers are probably close to the actual numbers interred; the percentage of immature individuals in each chamber is therefore similar, approximately 16–17 per cent.

Only two diseased bones were found, an arthritic shoulder and another example of cribra orbitalia. Levels of enamel hypoplasia, dental caries, calculus and unusual wear patterns are similar to those in the west chamber.

At the entrance lay a contracted male skeleton, almost complete and only slightly disarranged. This was presumably one of the last burials, if not the last. The age is between 22 and 43 years. Although male, a preauricular sulcus (type 'GP': Houghton 1974) was present; this generally female characteristic was quite frequent, so it was probably a population feature (cf. Lahr 1987). Most of the long bones could be reconstructed, so that the stature could be estimated at 159 cm. Tooth wear was minimal, as is usual with material from this tomb, and five teeth showed enamel hypoplasia (see above).

Near this skeleton were two bone groups articulated or readily associable. The first is a right forearm found apparently disarranged in the tomb. When these elements were disarranged in the tomb, decay had separated hand and arm, but the hands themselves were intact. Similarly, the second group consists of the somewhat disordered fragments of an adult, an adolescent and a child. That these were still close together suggests they were some of the last burials.

11.1.6. Other Żebbuġ material

Pure Żebbuġ skeletal material was relatively sparse outside the chambered tomb. It amounted to 467 fragments of bone of which 15 per cent was unidentified. There were a minimum number of four adults (one young), with as many as two subadults and two children. The only possible sex attribution was male. Some other deposits contained strongly residual Żebbuġ phase material (most especially 595). A more detailed programme of dating will be able to assess this issue.

Table 11.1. *Distribution of Tarxien deposit size.*

| Size range of deposit (no. of fragments)	No. of deposits in each size range	Total no. of fragments from each size range	% of fragments in each size range
0–1000	269	34,965	18.33%
≤2000	15	20,129	10.55%
≤3000	4	10,113	5.30%
≤4000	1	3333	1.75%
≤5000	2	9211	4.83%
≤6000	0	0	0.00%
≤7000	1	6783	3.55%
≤8000	1	7823	4.10%
≤9000	0	0	0.00%
≤10,000	1	9053	4.75%
10,000+	4	89,364	46.84%
Total	298	190,774	100.00%

11.1.7. Tarxien

The Tarxien deposits were dominated by a few large and many small deposits (Table 11.1). The 190,774 fragments of skeletal material were arranged in 298 contexts, dominated by 29 deposits with more than 1000 fragments, containing 155,809 fragments or 82 per cent of the material. The four largest deposits of more than 10,000 fragments contained 89,364 fragments or nearly 47 per cent of the material. The 269 smallest deposits of less than 1000 fragments contained 34,965 fragments or nearly 19 per cent of the material.

11.1.8. The packaging of burial parts

The most frequent body part was the skull providing a MNI of 822, followed closely by femora, humeri and ulnae (Appendix 9.1). The context-specific results are not strictly an outcome predicted on taphonomical grounds (Waldron 1987) since femora and proximal ulnae are very dense and hence sturdy bones, whereas the humerus is relatively fragile; other relatively dense bones are the patella, tibia, carpals and tarsals, which might be expected in large numbers. This provides another indication that cultural practices had the dominant impact on the formation of the deposit. In addition, many of the body-part frequencies of the individual deposits differ markedly from this collective base line, suggesting clear structure within the deposit. This can be illustrated most succinctly by showing the relative presence of the body along three dimensions: skull, limbs and what we have defined as 'residuals', or the parts that are left behind when skulls and limbs are moved (patellae, metacarpals, metatarsals, carpals, tarsals, phalanges, vertebrae etc.). We can thus construct a model of four sectors (Fig. 11.4):

the anatomically correct, the residual-dominated, the limb-dominated and the skull-dominated. For this purpose, the highest MNI value has been taken for skulls, the most highly represented limb bone and the most highly represented residual bone. No attempt has been made to average the MNI representation of the other seven limb bones and other residual bones. Employing this simple analysis, five of our selected deposits lie very close to the anatomically correct model (albeit sometimes unarticulated) where the minimum number of individuals for skulls, the most highly represented limb bone and the most highly represented residual are roughly equal. Three of these are stacked (1268-1206-960) around and under the 'Shrine' at the centre of the site. A fourth is the basal deposit (799) of the northern (Threshold) entrance pit. The fifth is the collection of skeletons in the innermost part of the East Cave (1241). Of these, (960) is the most balanced whereas the others all have a surfeit of residuals (and a corresponding contribution of clearance of skulls and limbs to other locations).

Three further deposits have suffered this effect even more markedly. The most prominent of these is the large burial area adjoining the 'Shrine' in a central position 'display area' on the site which contained, by some degree, the largest collection of bones, none of which was fully articulated as complete skeletons (783). A deposit in a southern alcove of the East Cave (595) has a similar profile to (783), whilst a smaller deposit on the southwestern side of the site (856) was even more dominated by residuals. An example of a deposit dominated by residual bones is (135) at the basal level of the deep sounding into the North Cave, which was chiefly made up of the atlas (cervical vertebra) body part. The limb-dominated and skull-dominated deposits appear to be caused by intentional actions of selection which drew on the residual-dominated deposits as a source of differently packaged secondary skeletal desposition. The most prominent of these are deposits (951) and (1111), where material appears to have been deliberately placed or even dumped in two of the physically lowest deposits on the site adjoining (783) to the north. At the other apex of our diagram (Fig. 11.4), skull-dominated deposits include (354) at the top of the northern bone pit and of the larger deposits (1254) immediately to the north of the 'Shrine' where considerable numbers of skulls were probably displayed prominently on the left side of the entrance to the cave system. Furthermore, these deposits are distributed precisely to the left (skulls) and right (limbs and skulls) of the entry point to the site where ritual specialists would have had maximum accessibility. There was no evidence of
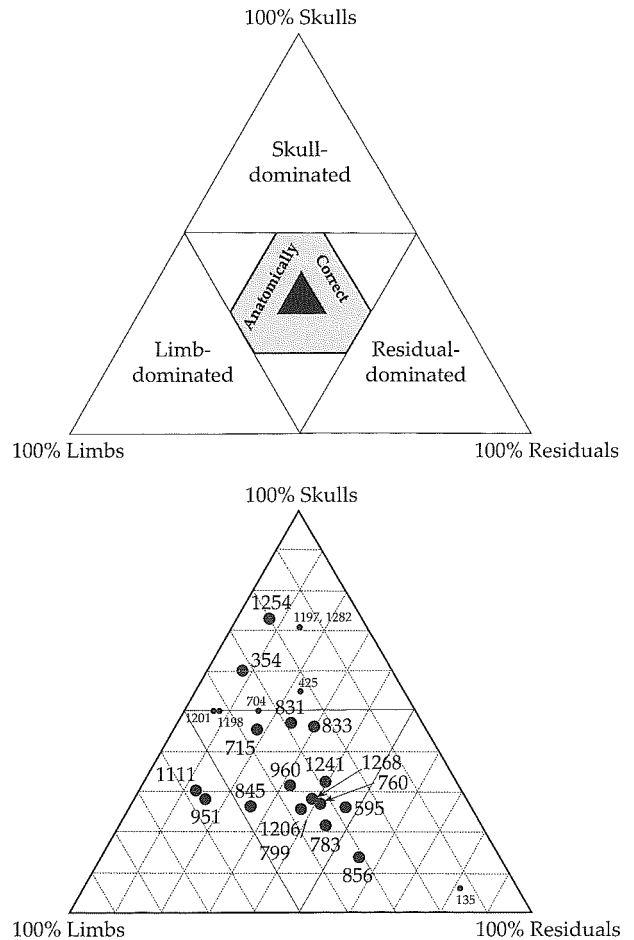
**Figure 11.4.** *Relative proportions of skulls, limb bones and residuals: a) basic model; b) contexts.*

exposure of the bones, either to the elements or to the action of animals. This suggests that the burial enclosure was precisely that, enclosed.

11.1.9. The overall patterns of age and sex
(Apps. 9.2–9.3)
The patterns of age have been implemented by calculating the MNI[22] for each aged body part in an attempt to make an allowance for movement of body parts across the site. This was first done for the raw age categories produced by the analyses (Fig. 11.5a), and then by recalculating the MNI for each coarser age category (Fig. 11.5b). In this second chart, the MNI for teeth is excluded and the next category, skull, taken as the MNI to avoid excessive double counting. The results are necessarily fairly coarse, but do show that all age categories were considered for inclusion in formal burial, and that non-adults may approach 45 per cent of the population, in comparison with 17 per

2. Only the original calculation of MNI in the individual contexts took siding into account.

a

b

c
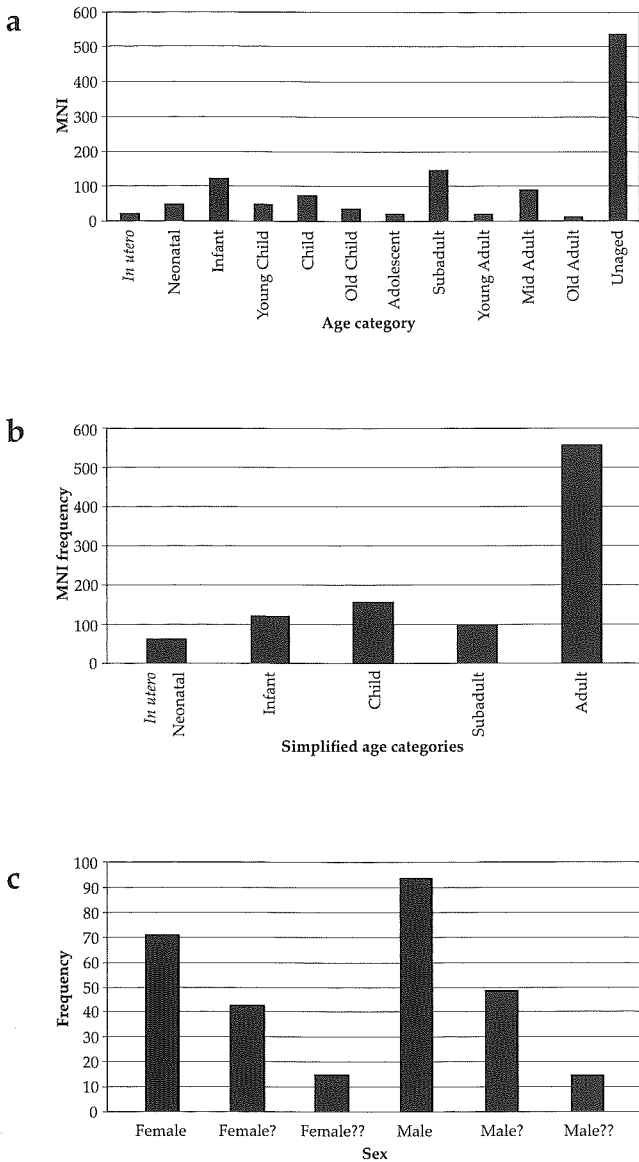
Figure 11.5. *Distribution of age and sex in the Tarxien deposits.*

cent for the sealed Żebbuġ rock-cut tomb. Younger age categories are almost certainly under-represented (probably for reasons of both taphonomy and exclusion from the formal burial record). We can identify, nevertheless, a slight peak in mortality during childhood, although when translated into a rate of death, the peak was probably in the shorter time-spans of neonatal and infancy, which probably reflects the prominence of infectious diseases that leave little trace in the osteology. These final figures give an approximate total for pure Tarxien contexts of 559 adults, 101 subadults, 156 children, 122 infants and 63 perinatals, a total of 1001 individuals from these pure contexts,

representing 153.83 fragments of bones per identified individual (which when living would have had 206 bones in the body of each individual), although the differential effects of fragmentation on different parts of the skeleton need to be taken into account.

The patterns of sex have been implemented by calculating the MNI for each aged body part in each context, and totalling the result (Fig. 11.5c). The vast majority of attributions are based on skull and pelvis, without cross-reference. As can be gathered from the preceding discussion, the lack of articulated bodies makes analysis problematic at the level of the individual, and only some idea of the relative access by biologically different sexes to the formal burial rite can be assessed. This suggests that both males and females were granted access to the burial rite, although males may have been given slightly greater access (in a ratio of 94:71), perhaps because they are prominent in some significant deposits (e.g. the base stratigraphy of (1328) in the 'Shrine', and the base (799) and top (354) of the northern (Threshold) burial pit, as against an equal balance in most other parts of the site.

11.1.10. Potential corrections of MNI
The analysis of MNI from specific contexts is useful for the interpretation of the movement of human bones as part of the burial process. However, it was thought prudent to undertake further analysis to assess the range of minimum MNI. A simple correction is the recognition that 78 contexts had a skull-derived MNI of just one individual and it is conceivable that the greater ease of recognition on skull as opposed to a specific limb bone may have led to double counting. However, even if these figures are subtracted from the total MNI, skulls still remain the most frequent body part (744), although by a smaller margin to femora (735). A more radical correction can be made if all the skulls are considered to be from one precisely contemporary deposit and clumped together. If this (incorrect) assumption is made (see discussion in Chapter 14) the MNI of the total population falls dramatically to 361 based on skull, 423 based on ulna, 341 based on femora, 437 based on patella and 355 based on phalanges. Figure 11.6 shows the range of extreme outcomes for selected body parts.

11.1.11. Description of significant intact individuals (GM, SS)
The process described above left only a few individuals anatomically intact and a few others anatomically related (in other words, gathered together as a package). The most prominent examples are described here in osteological terms, in context order for ease of reference, whereas their relationship to each other

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has already been described in the spatial and stratigraphic section of this volume (Chapter 8). Additional methods of analysis are provided to give specific support for each of these identifications necessarily to supplement the general methodological guidance at the beginning of this section.

11.1.11.1. Context 518 (97E/113N) (Fig. 8.60:A)
The upper torso, right arms and head of a female, partly displaced from a crouched position, was orientated approximately east–west, with the head slightly knocked out of position. The skeleton was sexed on the basis of the characteristics of the skull (brow, orbits, mastoid, nuchal crest, temporal bone, frontal bones). The main interest in the skeleton lies in the dentition, which exhibits enamel hypoplasia (LM^2, LM^3, RM^2, RM^3), attrition (LM^1, LM^2, LM^3, RM^1, RM^2, RM^3), calculus (RM_1) and periodontal disease (but note not caries) (RM_1, RM_2, RI_1, RI_2 RC_1, LM_1, LM_2, LI_1, LI_2 LC_1). Abnormalities include crowding of the upper incisors and a 45° rotation of LPM^2.

11.1.11.2. Context 783 (96E/111N) (Figs. 8.61:C, 8.62b)
A female adult was placed on her right side with the face looking south and the skull pointing to the west, orientated east–west, with the feet drawn up to the torso. The skull was too badly preserved to give a definitive sexing of the skeleton, but observations of the pelvis in the ground suggest a female. The maxilla has recession of alveoli and loss of RC^1. RI^1 and LI^1 are worn heavily on lingual side. LM^2 socket has evidence of abscess and sinusitis. The mandible has evidence of severe undercutting and recession of alveoli. RC_1 has wear on the mesial side, and caries at the enamel junction on the buccal side. The thoracic (porosity, lipping and osteophytosis) and lumbar (lipping and pitting) vertebrae showed mild evidence of arthritis. There was also some evidence of lipping and porosity in the sacrum and porosity and mounding of the pelvis. The combined evidence of two tibia and one femur suggest a stature of about 1.6 m.

11.1.11.3. Context 799 (107E/114N) (Fig. 8.8g)
A complete and well-preserved crouched individual, with the spine orientated north–south and the head slightly bowed towards the west, was found almost at the very bottom of the northern entrance bone pit. Methods for sex determination were based on two morphological and metrical criteria. Morphological assessment of the pelvis and skull was based on methods described by Krogman & Iscan (1986) and Bass (1987). Stature was calculated from the regression formulae of Trotter & Glesser (1952) for American White populations.
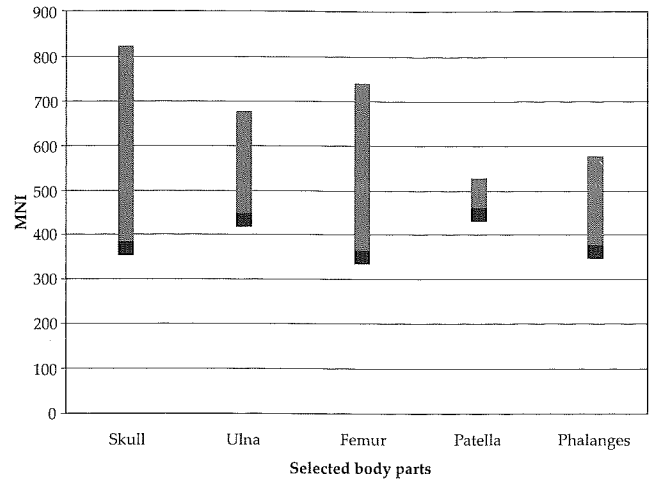
Figure 11.6. *Comparison between two calculations of total MNI: upper limit - sum of MNIs in each distinct context; lower limit - MNI in the cumulative Tarxien-dated deposit regardless of context.*

The observed features of the skull included pronounced supra-orbital ridges, large mastoid process, strong muscle markings on the nuchal crest, features observed on the pelvis included a short pubic ramus, narrow sub-pubic angle, acute angle formed by the sciatic notch, absence of preauricular sulcus, and these present male characteristics. The morphology of the sacrum, although not in very good condition was also observed, and it presented the anterior curvature common in males (extended from S1–S5). The mandible presented a square chin and heavy muscle attachments. Measurements of the head of both femora, one humerus and one radius fall into the male range.

Owing to the state of preservation, age was difficult to assess. Only examination of the ilium auricular surface proved to be applicable. The observable characteristics are densification of the surface and moderate activity of the retroauricular area which correspond (according to Lovejoy *et al.* (1985b)) to an age range of 35–45 years. Dental attrition was not used as an ageing method as it has proved to be unreliable for this population. The stature of the individual from the maximum length of the femora, tibia and one ulna is approximately 1.77 m.

Some observations can be made regarding the health of the individual. The altered shape of the mandibular condyles (caused by bone proliferation around auricular areas) seem to have been a result of malocclusion. This might have been caused by a large abscess on the left mandible (first molar). This lesion was probably causing pain to the individual in life. Osteophytosis was observed around the bodies

of some of the lower thoracic and lumbar vertebrae. They were likely to be age-related and are therefore normal. Bone proliferation and eburnation were observed around the heads of some metatarsals, and it is worthwhile noting that similar lesions have been observed in other individuals in this population. They will give us some information about the joint degeneration suffered by these people, although the causes still remain obscure.

11.1.11.4. Context 960/4 (99E/112N) (Fig. 8.50:A)

A partly articulated bundle burial, with the head orientated to the northwest facing east, and the legs drawn up to the face. This is the most intact articulated burial in this context, the upper part of the 'Shrine'. The skull was highly fragmentary, but sufficiently intact to give an adult male attribution because of its robust features. The pelvis, although present, was insufficiently intact to confirm this attribution. There was evidence of some alveolar reasorbtion (LM_2), enamel hypoplasia (LPM^1, LPM^2, LM^1), calculus (LI^1, LI^2, RI_1, RI_2, LI_2, LC_1, LPM_1, LM^1), caries (RP_2, LM_1), attrition (RM^1). parafunctional wear (RPM_1) and at least one tooth lost ante-mortem (RM_2). Wear states suggested an age between 17 and 25 (Brothwell 1981), but this should be interpreted with caution in this population. No other disease features were noted. The stature was difficult to assess since the lower limbs appeared to be disproportionately short for a male and in comparison with the upper limbs. If the assumption is made that this individual was male, the lower limbs suggest a maximum height of 1.5 m (whereas the humerus suggests proportions that might match 1.61 m).

11.1.11.5. Context 1241/5 (107–8E/103N) (Fig. 8.67:C, D)

A relatively complete child's skeleton (Fig. 8.67:D) in a crouched position on its right side, orientated with the head directed towards the northeast and the back approximately south. The skull was that of a five- to six-year-old child on the basis of dentition and state of fusion of limbs, with no visible abnormalities.

The upper torso of a relatively complete adult skeleton (Fig. 8.67:C) orientated approximately east–west, placed on the left side with hands drawn up to the face, with back to the south. The slightly displaced skull is of an adult female. The non-union of the acromium of the scapula and the medial epiphysis of the clavicle suggests a younger individual, perhaps less than 25 years (Bass 1987, 120, 129). If the associated radius is of a female, then the overall stature is in the order of 1.43 m, whereas the humerus suggests a slightly higher individual of 1.47 m, with a robusticity index of 18.56.

11.1.11.6. Context 1241/6 (106E/105N) (Fig. 8.67:E)

The torso, skull and upper limbs of a slightly red ochre stained crouched probable male, orientated north-east–southwest, with the head towards the southwest placed on the left side. Skull and mandible appear to be male, although not definitive on basis of brow ridges, and less convincingly mastoid processes, chin and occipital crest. Teeth have very little wear. Pelvis appears to be male from sciatic notch, although sacrum has a female shape. Some lipping is apparent on the lumbar vertebrae.

11.1.11.7. Context 1241/6 (108E/104N) (Figs. 8.67:B, 8.68)

The upper torso of a male on his side with the head orientated towards the east-northeast, facing northwest, with the right hand flexed towards the face, accompanied by an offering bowl. The skull was defined as male because of the robustness of the orbits, the frontal and the brow, the well-marked temporal line, the zygomatic process and the chin. There was evidence of slight periodontal disease (RM^1, LM^2, RM_1, RM_2, RM_3, LC_1, LPM_1), more extensive calculus (LI^2, LC^1, LM^1, LM^2, RI_1, RI_2, RC_1, RPM_1, RPM_2, LI_1, LI_2, LC_1, LPM_1, LPM_2, LM_1, LM_2, LM_3) and one instance of caries (RM_2). Some loss of the upper front teeth appears to have been ante-mortem (e.g. RC^1). There was considerable attrition to the anterior mandibular teeth. LM^2 had particularly heavy calculus with accompanying recession of the alveolar bone. There was also resorbtion of bone at RM^1 and reactive bone at RM_3. There is localized (parafunctional ?) wear on localized teeth (e.g. RPM_1, RPM_2, LM^2, LM^3) as well as more general attrition on the molars in both jaws. The general wear state of the teeth suggests an age of 17–25 years, but this must be viewed with the same caution as analysis with other members of this population. The left mandibular condyle exhibited lipping, porosity and eburnation, accompanied by porosity and mounding on the mandibular fossa, combining to suggest arthritis in this location.

The remainder of the body was only preserved to a limited extent (right clavicle, right scapula, ulna, humerus, radius, both hands, caudal and thoracic vertebrae). There was slight pitting on the right clavicle. The combined evidence of the length of these limbs suggests a stature in the order of 1.67 m. The humerus has a robusticity index of 19.9. The ulna has a calibre index of 16.6.

11.1.11.8. Context 1241/6 (108E/104N) (Figs. 8.67:A, 8.68)

The full body of a female (her feet remain unexcavated) was placed in the same orientation and pose as the male beneath her, transposed slightly to the east. The smooth gracile qualities of the cranium (brow,

orbit, mastoid, right nuchal crest, brow) (in spite of some male qualities of the zygomatic process and the temporal bone), and the narrowness of the mandible all confirm a female. Cranial suture enclosure suggests a mature individual. There was evidence of slight periodontal disease (LM^1, LM^2, RM^1, RM^2), more extensive calculus (LC^1, LPM^1, LM^1, LM^2, RM^1, RM^2, RI_1, RI_2, RC_1, RPM_1, RPM_2, RM_1, RM_2, LI_1, LI_2, LC_1, LPM_1, LPM_2, LM_2) and two instances of caries (LM_3, RM_3). LM_3 and RM_3 were over-erupted and the corresponding teeth (LM^3 and RM^3) impacted. There is a very distinctive wear on the front teeth of the mandible and maxilla from either tooth to tooth contact or some form of parafunctional wear.

The scapulae, ribs, manubrium and sternum show evidence of lipping and porosity. The seventh and eighth rib have evidence of a healed fracture, and the eighth and ninth ribs also show developmental abnormalities The humerus is generally gracile, with a robusticity index of 20.33, and shows some lipping. The ulna has some lipping and a robusticity index of 18.17. There is lipping/porosity on some of the metacarpals and other hand bones. The pubic arch corroborates the female attribution. The vertebrae exhibit signs of age and arthritis, including depressions, spicule, growths and lipping, and there is some lipping on the femur; although it was insufficiently preserved for measurement of stature. The humerus suggests a stature of 1.47 m; the ulna 1.52; the radius 1.54.

11.1.11.9. Context 1250 (103E/107.55–108.55N)
(Figs. 8.57, 8.58)
A partly extended skeleton, slightly tilted onto the left side, was a poorly preserved, mid (?) adult female, with the legs drawn up in a kneeling position behind the body, orientated in a north–south direction with the head to the south. The sexing was based both on surviving fragments of the skull (nuchal crest, orbits, mastoid and mandible) and pelvis (assessed in the ground). There was considerable evidence of porosity, lipping and pitting in the pelvic region, some lipping in the lumbar vertebrae, and osteophytes/lipping/porosity in the hands and lipping in the feet, signifying age and arthritis. The only measureable bone was the right humerus which gave an estimated stature of 1.4 m.

11.1.11.10. Context 1268 (98–9E/109–10N) (Fig. 8.45:A)
A relatively complete and well-preserved male crouched individual, with the spine orientated northwest–southeast and the head slightly bowed towards the west, was found in the penultimate bottom layer beneath the 'Shrine'. At the time of excavation this was thought to relate to the one individual, although there is a slight

disjuncture between the torso/upper body and the pelvis/lower limb, and although consistently male, there is a difference in ageing between dentition and pelvis.

The observed features of the skull (brow ridges, mastoid process, temporal and frontal sinuses), mandible (robust and broad), chin and well-marked muscle attachments of medial pteryoid all indicated a male. The pelvis was also male.

Age was difficult to assess from the skull, although the coronal, sagittal and lamboid sutures were closed. The attrition of the teeth suggested a relatively young age of 17–25 years (Brothwell 1981), but such techniques have proved difficult to assess in these populations. The pelvis as measured from the pubic symphysis (Brooks & Suchey 1990) and the auricular surface (Lovejoy et al. 1985a,b) suggests an age of 40 to 50.

The stature of the individual could not be assessed although an average of two articulated femurs immediately to the south suggested a stature in the order of 1.7 m according to criteria for white males (Trotter 1970).

The teeth suffered from moderate to considerable periodontal disease on right and left 6–8 on both upper and lower jaws, a consequent abscess on the first left molar, as well as calculus on many of the teeth, particularly in the lower jaw. There was also pitting on the teeth suggesting fluorosis from the local water supply, which otherwise seems to have provided a measure of protection. The tibia, fibula, patella, vertebrae and pelvis had lipping.

11.1.11.11. Context 1268 (99E/110N) (Fig. 8.45:B)
A crushed, constrained, crouched and contorted individual was pressed into a pit, the spine orientated northwest–southeast with the legs brought out of anatomical relationship, alongside the body, and placed above the preceding body.

The observed features of the skull (gracile orbits, nuchal crest, frontal, temporal) and long bones are female. Age was more difficult to assess but the complete fusion of the parietal, lamboid and coronal sutures suggests a post-menopausal age.

The stature of this individual may have been as little as 1.54 m based on the maximum length of the humerus.

The health of the individual was not good. The maxilla and mandible had suffered heavy tooth loss prior to death, with locally reactive bone (sinus at root of LP_1) and caries. Additionally, there was evidence of lipping on the caudal vertebrae, pelvis and left patella, and pitting on 80 per cent of the right femur head suggesting arthritis, or more specifically, Reiter's syndrome, perhaps promoted by the poor health of

the individual prior to death. The humerus exhibits an exaggerated dorsal tuberosity

11.1.11.12. Context 1268 (100E/109N) (Figs. 8.46:A, 8.47)
The distinctive torso (including pelvis), arms and head of a mature women, bearing a cowrie-shell headdress, with crushed legs and covered in red ochre was orientated northeast–southwest.

The observed features of the skull (supra-obital ridge, orbits, zygomatic, nuchal area, occipital condyles and mastoid process) are female. This was confirmed by the sciatic notch on the pelvis. Age was more difficult to assess but the state of the vault and lateral anterior sutures (Meindl & Lovejoy 1985) suggests an age between 34 and 68 years. The surface of the pelvis also suggested a mature adult. The cranial index is 72, characterized as dolichocrany or long-headed (Bass 1987, 69)

The stature could only be calculated from the length of the left ulna, partly confirmed by an *in situ* measurement of the left humerus, as between 1.52 and 1.56 m.

The dentition had some pathology. On the maxilla, there was hypoplasia on the left incisors and the canine, an abscess on the first left molar, some periodontal disease on the left molars and the right premolars. There was a developmental problem in the non-eruption of the third right molar. On the mandible there was caries on the first two left molars, calculus on the majority of teeth and some periodontal disease. Most interestingly, there was a distinctive facetted wear on the premolars and canine of the lower jaw, matched by less-distinctive wear on three of the corresponding teeth in the upper jaw. The left articular surface of the sacrum was extended abnormally with considerable bone proliferation, and badly articulated with the fifth lumbar vertebra. Some of the lower thoracic vertebrae presented bone proliferation around the articular surfaces. All five lumbar vertebrae had bone proliferation. One humerus had a well-healed fracture.

11.1.11.13. Context 1328 (98–9E/110N) (Figs. 8.43:D, 8.44b)
The upper part of a crushed individual, with hands brought up to the head, with the spine orientated approximately east–west was found at the very bottom of the 'Shrine' sequence. Stature was calculated from the regression formulae of Trotter & Glesser (1952) for American White populations. The observed features of the skull (prominent chin and strong muscle markings on the nuchal crest) suggest male characteristics. The incisors and canines were worn down to the dentine, particularly on the mandible. There was some lipping and deformation of the ribs. The pelvis was missing. Insufficient evidence was present to give an accurate

assessment of age other than adult. The estimates for stature based on the maximum length of the ulna (the only intact limb bone) ranged between 1.71 and 1.8 m. The calibre index (Bass 1987, 169–70) of robustness was 14.72.

11.1.12. Stature
The study of stature is a problem, given the fragmentary nature of the long bones. In the case of articulated bodies, stature has already been given. In the case of disarticulated limbs sex cannot be assessed so a probable range for adults is between 1.52 m and 1.8 m.

**11.1.13. Pathology and other observations**
The overall pattern of pathology in the full sample is its relatively low frequency (about 1.6 per cent of identified fragments), given the very large size of the sample, although increased in comparison with the closed context of the Żebbuġ rock-cut tomb (at 0.6 per cent of fully identified fragments). Some of the differences may also reflect the less-fragmented quality of the Tarxien material. Of the 2891 observations of pathology (outside the already studied Żebbuġ rock-cut tomb), joint disease (1100 - 38 per cent), dental disease (649 - 23 per cent) and habitual activities (in large proportion dental wear related to habitual activity) (569 - 20 per cent) predominate. Joint disease is dominated by osteoarthritis (849 - 77 per cent of joint disease), and eburnation (157 - 14 per cent of joint disease), although extra cortical new bone and possible spondylitis have been noticed. A significant observation is that there was a high incidence of flattening of the distal joints of the first metatarsal, whereas standard osteoarthritis would be expected in the proximal joint. The flattening of distal joints may indicate an unusual use of the joint, colloquially known as game-keeper's thumb. This flattening was concentrated on the right thumb, suggesting a habitual sided activity, which may be connected to the use of the teeth as a third hand or clamp (wear facets). Dental disease is dominated by the presence of dental calculus (265 - 41 per cent of dental disease) and caries (219 - 34 per cent of dental disease), although some abscesses (36) and antemortem tooth loss (75) have been noted. Pathology related to habitual activity is dominated by dental wear (482 - 85 per cent), most particularly facetting on the incisors and canines of some individuals. Some squatting facets were also noted. The most notable of other observations include: infection (79 - 3 per cent), mainly non-specific, but also examples of sinus infection and osteomyelitis; neoplasia; extra cortical new bone; and myositis. Developmental alterations were also noted (wormian bones and metopism). Indicators of stress such as enamel hypoplasia (130 obervations), cribra orbitalia (20 observations) and porotic hyperos-
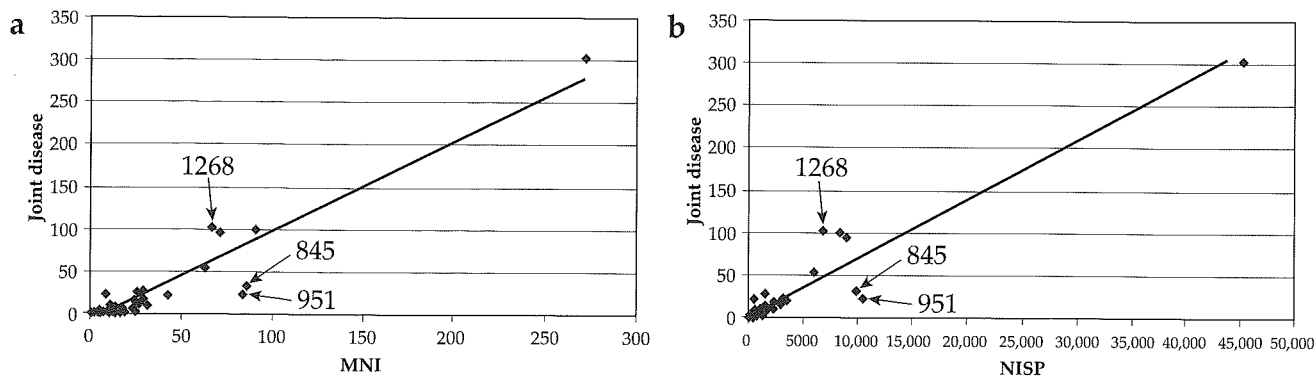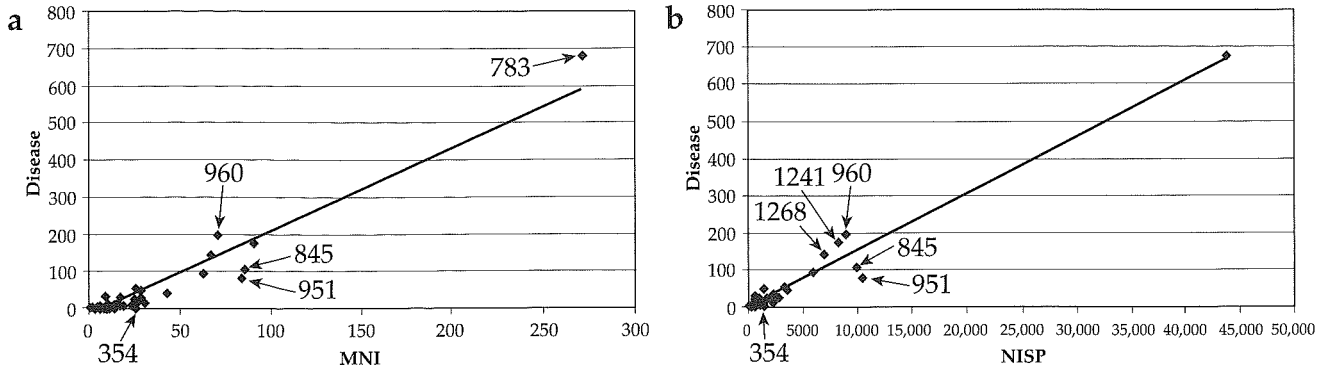
Figure 11.7. *Scatter diagrams comparing incidence of joint disease against: a) minimum number of individuals (MNI); and b) number of identified specimens (NISP).*
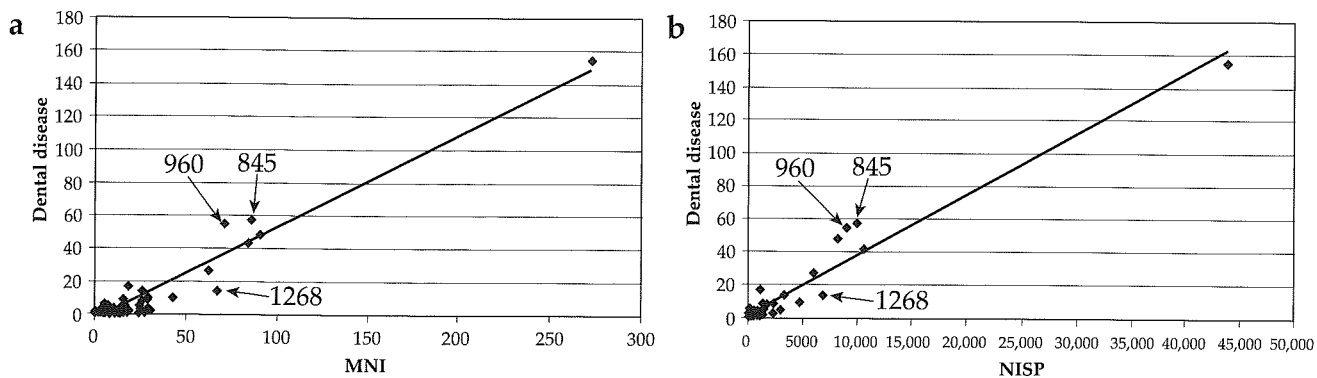

Figure 11.8. *Scatter diagrams comparing incidence of dental disease against: a) minimum number of individuals (MNI); and b) number of identified specimens (NISP).*
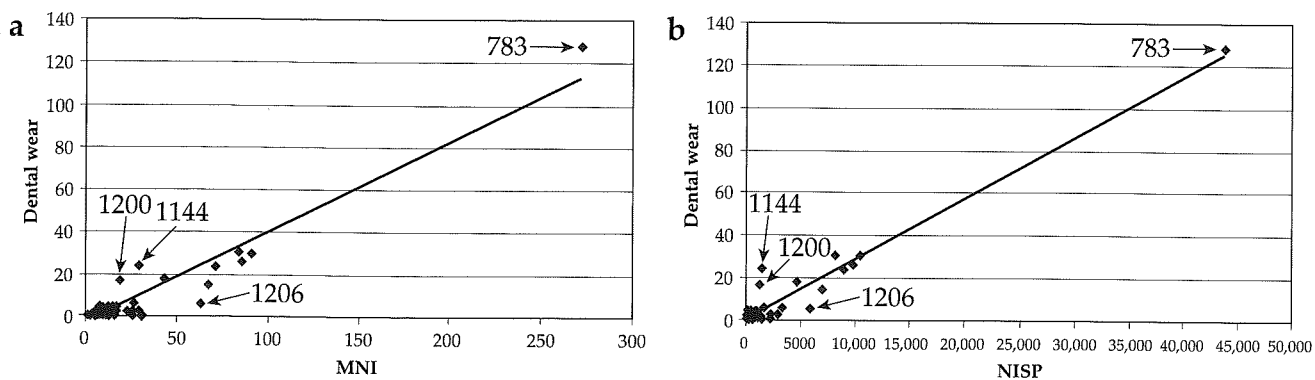
Figure 11.9. *Scatter diagrams comparing incidence of dental wear against: a) minimum number of individuals (MNI); and b) number of identified specimens (NISP).*

Figure 11.10. *Scatter diagrams comparing incidence of disease against: a) minimum number of individuals (MNI); and b) number of identified specimens (NISP).*
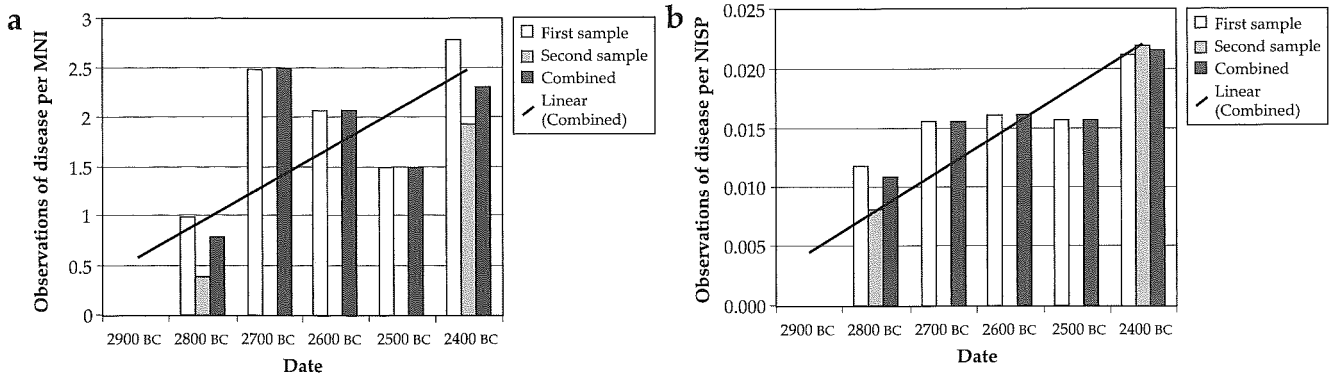

Figure 11.11. *Trend of disease over time employing: a) minimum number of individuals (MNI); and b) number of identified specimens (NISP).*

Table 11.2. *Simplified presentation of incidence of disease in major deposits.*

Selected contexts	354	783	845	951	960	1206	1241	1268
Joint disease	-----	++	---	---	++			++
Dental disease	-----	+	++		++			---
Dental wear	-----	++				--		
Stress indicators	-----	++	--		++			
General disease	-----	++	---	--	++			
Trauma	-	-	-	-	-	-	-	-

Comparison of some major deposits (----- very low, --- relatively low, -- low, - negligible, ++ higher incidence)
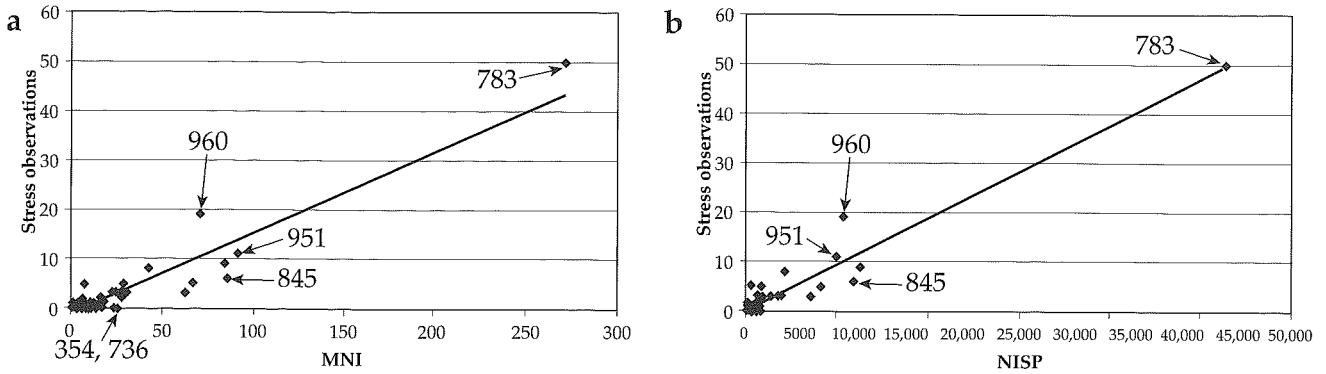
Figure 11.12. *Scatter diagrams comparing incidence of stress indicators against: a) minimum number of individuals (MNI); and b) number of identified specimens (NISP).*
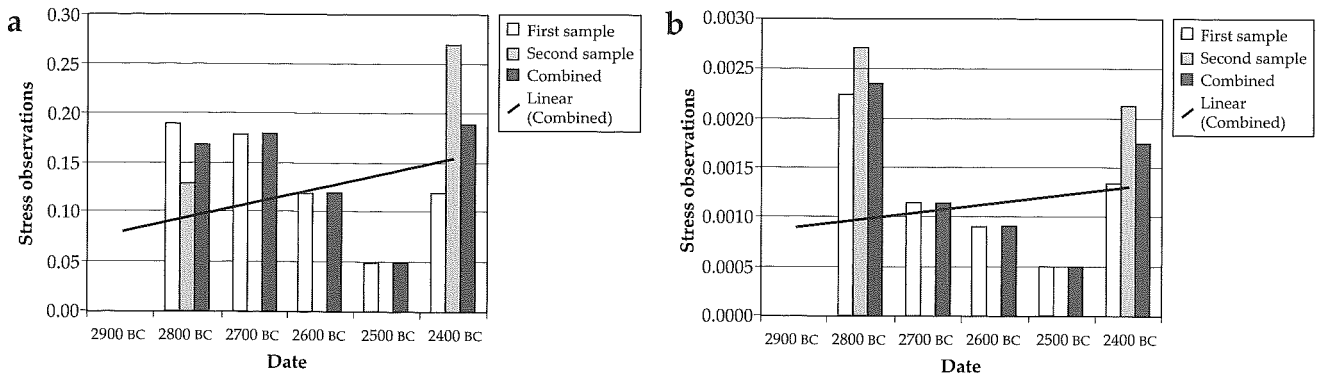
Figure 11.13. *Trend of stress indicators over time: a) minimum number of individuals (MNI); and b) number of identified specimens (NISP).*

tosis (10 observations) are relatively low in comparison with other populations, although this issue is discussed further in the connection with Tarxien deposits below. Trauma (bone fracture) is also little represented (only 40 observations). A significant number of auditory ossicles were recovered. There was no trepanation or other evident intervention. The bones do not appear to have been gnawed by animals or exposed to the elements and thus the Circle must have been well enclosed by a gate as well as a symbolic enclosure.

11.1.13.1. Tarxien pathology

The securely stratified Tarxien deposits deserve detailed treatment, comparing different deposits and looking at chronological trends. These comparisons must remain tentative given the need to provide greater control over chronology, frequency of body parts and degree of fragmentation.

Various forms of joint disease have the highest frequency and appear to be concentrated more in some burial deposits than others (Fig. 11.7). Deposit (1268), a deeply situated deposit of relatively high articulation below the 'Shrine', which contains the female with the cowrie headdress (1268 (100E/109N), Figs. 8.46:A, 8.47) described above (§11.1.11.12), and (960) which is located higher in the 'Shrine' sequence, appear to have higher frequencies than (845) from the north niche, or the disarticulated deposit (951) from a lower part of the site. There are thirteen cases of spina bifida of which four are in (783). However, most cases reached adulthood and only one (immature) had severe symptoms. There is also evidence of Schmorl's Nodes in a number of instances. Deposit (1201) has an instance of the complete disorganization of the right temperomandibular joint, represented by a temporomandibular cavity 20 mm across. The bone formation is pitted and roughened and some new bone formation is placed around the edges.

Dental disease is the pathology of next highest frequency (Fig. 11.8), although there is anecdotal evidence that there may have been some local protection because of the presence of natural levels of fluoride in the water (e.g. Murray *et al.* 1991). The lack of wear on teeth suggests strong enamel, and caries tends to develop in particular locations most notably at the junction of the enamel and dentine. Furthermore, there is the possible identification of fluorosis on

some teeth, which is a common condition in modern Gozitan populations. In other words, while the natural protection of fluoride in the water supplies may afford natural protection of the crowns of the teeth from both wear and caries, poor dental hygiene may permit caries, and in extreme cases abscesses, to form at the unprotected junction of enamel and dentine. The comparable frequency of calculus and caries may support this idea, although a more detailed study will need to be undertaken. Of the major deposits, dental disease appears in a higher frequency in (845) and (960) and at a lower rate in (1268).

In the absence of abrasion of the teeth by the dietary intake, perhaps because of the relatively soft limestone employed to grind cereals, most wear on the teeth appears to be related to a deployment of a 'third hand' on the incisors and canine. This habitual use appears to have caused a facetted wear on teeth in a number of individuals, most notably the female with the cowrie headdress described above (§11.1.11.12), Figs. 8.46:A, 8.47). The frequency (Fig. 11.9) is distributed differently to the other pathologies, with higher frequencies in (1200, 1144, 783). Low frequencies are visible in the large (1206) deposit. The teeth need to be investigated further to take this idea forward.

Examples of infection include chronic sinusitis, chronic ear infection (cholesteatoma) and acute mastoiditis leading to meningitis or septicaemia.

Overall patterns of disease appear to vary as much between deposits (Fig. 11.10, Table 11.2) as over time (Fig. 11.11). For this analysis, dental wear and trauma were excluded from the statistics. Taking all bone-affecting diseases together (Fig. 11.10), contexts (783) and (960) have the highest incidences, whereas contexts (951) and (845) have lower rates and (354) (even though dominated by skulls) had a complete absence of disease. To examine change over time, nine contexts dated directly by AMS dating have been arranged in chronological order (it should be noted that this is different from stratigraphical order, because some deposits, notably the northern Threshold bone pit, appear to be deliberately reversed). The resulting graph (Fig. 11.11) can be interpreted as evidence of an increase in disease over time, but the evidence is very tentative, with many intervening fluctuations. A greater range of AMS-dated samples need to be assessed in conjunction with more isotopic studies and more sophisticated statistical analysis to establish a clear pattern. A smaller range of indicators which might be indicative of stress (cribra orbitalia, porotic hyperostosis and enamel hypoplasia were also examined across space and time: Figs. 11.12, 11.13). The incidence of cribra orbitalia and porotic hyperostosis was very low (20 and 10 instances respectively)

and to the lower end of those encountered in cross-cultural studies (Rothschild *et al.* 2004). In the case of cribra obitalia only 35 per cent reached maturity. The relatively high rates of enamel hypoplasia appear to fit other trends in Mediterranean populations at the Neolithic–Bronze Age transition (Cucina 2002). Similar spatial distinctions emerged from these even less-weighty statistics (Fig. 11.12). It is possible that this contrast reflects seasonal rather than chronic deficiencies in diet (Goodman 1994) although this needs to be investigated further. Contexts (960) and (783) have the higher frequencies, (845) and (951) are again at the lower end of the scale and (354) and (736) completely lack such evidence. The same evidence was examined over time (Fig. 11.13) and the resultant graph shows a tentative increase in stress indicators over time, as well as even more considerable fluctuations.

Trauma (bone fracture) exists as a very low background frequency totalling a mere 40 observations from the Tarxien deposits. 38 per cent of these injuries are to the toe (metatarsals and phalanges), followed in order of frequency by the hand (26 per cent), teeth (5 per cent), collar bone (clavicle) (3 per cent), arm (3 per cent), leg (3 per cent), knee (2 per cent), ribs (2 per cent). There was one noticeable blow to the head on the nose. There was a slightly greater propensity towards damage to the right side.

11.1.13.2. Conclusions

Two major chronological phases are represented at the Circle: Żebbuġ and later Tarxien. The common factors between the two populations are generally a good state of health (including a possible natural protection of the teeth), a low incidence of trauma, and some distinctive parafunctional tooth wear. The most notable change is considerable increase in the number of individuals buried and the representation of younger members of society within the buried population. It is difficult to assess if this is a product of death rates or of social inclusion within the burial rite. There appears to be some evidence for deterioration of health, but this does not appear to accelerate so clearly during the Tarxien phase, although further work needs to be addressed towards this issue.

The burial rite expanded considerably in scale and processing of bodies during the later Tarxien phase. The Żebbuġ phase can be explained simply by the continual insertion of whole bodies (and the possible removal of selected body parts). The Tarxien pattern can be explained: 1) by the placing of bodies in deep parts of the stratigraphy, in some cases intentionally (e.g. (799) and probably (1328)) and in other cases pragmatically (e.g. 1241) where they were protected by later deliberate and/or accumulated deposits

(Stoddart & Malone in press); 2) by temporary display of bodies (zones high in residuals); 3) by redistribution of long bones and skulls into secondary locations. These themes will be developed in an integrated, interpretative and comparative manner in Chapter 14.

11.2. The animal bone (GB, DR, SS) (Fig. 11.14)

11.2.1. Introduction
This modest sample of nearly of 7000 fragments of animal bone is almost the only source of faunal evidence for prehistoric Malta collected to date. Most excavations of prehistoric sites were undertaken too early to collect animal remains. The more recent faunal report on Skorba is scanty in detail on this, as in many other respects (Gandert 1966). The most detailed report is that on the Xemxija tombs (Pike 1971a; Rodgers 1971) although there is some evidence (presence of horse, rabbit and deer?) that the tombs may have been subject to intrusive modern material.

All the animal-bone fragments from the Circle were identified by Geraldine Barber and subsequently analysed statistically by David Redhouse and Simon Stoddart, using direct knowledge of the archaeological context to provide as much a social anthropological as a faunal analysis (Chapters 7 & 8). The original identification was undertaken to species where possible, aged (Hillson 1986; Payne 1973; Silver 1969), sexed for sheep and goats (Boesseneck 1969) and measured using standard criteria (Von den Driesch 1976). For each bone the following was noted where possible: species, body part, side, age, sex, pathology and marks of utilization (cut marks, gnawing and burning). In the few cases of complete adults, measurements were taken according to the standards and landmarks established by Von den Driesch (1976). Minimum numbers of individuals were calculated using the adapted criteria (Chaplin 1971) of White (1953) and applied independently to contemporary groups of deposit, either contexts or phases of the site. In each case the calculation of MNI will be made clear. As already discussed (Chapter 6), there is considerable residuality within these deposits from earlier phases (particularly of Żebbuġ within Tarxien, and of Tarxien within Bayer), and these issues must be taken into account in any interpretation of the evidence.

11.2.2. The general characteristics of the faunal deposit
The deposit comprises some 6841 fragments of animal bone (less than 3 per cent of the quantity of recovered human bone) where a minority of fragments (47.7 per cent) could be identified to species. This probably reflects primarily the intensive recovery strategy rather than the state of preservation of the bone. As an
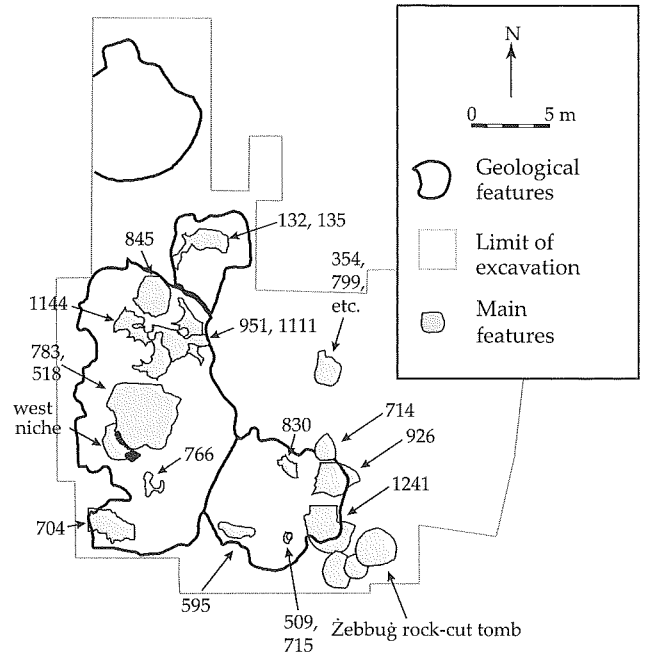
Figure 11.14. *Location of major animal-bone deposits in the Circle.*

illustration of this, the superficial Tarxien Cemetery rubbish deposits appear to have been subjected to a more considerable attrition leading to a lower identification rate (32.6 per cent) compared with the easier identification of the more intact and deeply stratified offerings of the Tarxien phase (51.5 per cent). This distinction is supported by the higher rate of visible wear on Bronze Age bones (3 per cent) compared with Tarxien bones (1 per cent). The combined deposit from all parts of the Circle was dominated by sheep/goat, followed by a roughly equal proportion of cow and pig among the major domesticates whether measured by identified fragments or minimum numbers of individuals (Tables 11.3, 11.4). Other animals were present in very low quantities, particularly if a nineteenth-century dog burial is excluded.

11.2.3. Individual species
Some general characteristics of the species within the deposit will be covered before analysis of the principal phases of the site.

11.2.3.1. Sheep/goat
Sheep/goat was much the largest identifiable constituent part of the assemblage (2298 fragments - 33.6 per cent). In the discussion of individual species across all phases, the total MNI has been calculated by assessing the MNI in each phase and then adding these calculations (making the assumption of no overlap or

Table 11.3. *Summary of NISP animal-bone data.*

Summary of NISP data for whole sample			% without unidentified	% mammals	% domesticates	% major domesticates
Bird	29	0.4%	0.9%			
Cat	12	0.2%	0.4%	0.4%		
Cow	290	4.2%	8.9%	9.1%	9.6%	10.3%
Dog	214	3.1%	6.6%	6.7%	7.1%	
Frog	59	0.9%	1.8%			
Mouse	142	2.1%	4.3%	4.5%		
Pig	218	3.2%	6.7%	6.9%	7.2%	7.8%
Sheep/goat	2298	33.6%	70.4%	72.4%	76.1%	81.9%
Unidentified	3579	52.3%				
Total	**6841**		**3262**	**3174**	**3020**	**2806**

Table 11.4. *Summary of MNI for animal bones.*

	Bird	Cat	Cow	Dog	Frog	Mouse	Pig	Sheep/goat
Żebbuġ	0	0	1	0	0	0	1	2
Żebbuġ (Ġgantija)	0	0	1	0	0	0	1	2
Tarxien (Żebbuġ)	0	0	1	0	0	0	1	2
Tarxien	3	3	4	2	3	6	5	19
Rock fall	0	0	1	0	0	0	1	2
Tarxien Cemetery	1	0	2	1	0	0	2	7
Borġ in-Nadur	0	0	1	1	0	0	1	4
Bayer	0	0	1	1	1	0	1	3
Agricultural	0	0	1	1	0	1	1	2
Unstratified	0	0	1	0	0	0	1	2
MNI additive	**4**	**3**	**14**	**6**	**4**	**7**	**15**	**45**

Table 11.5. *Numbers of body fragments for all species across all phases.*

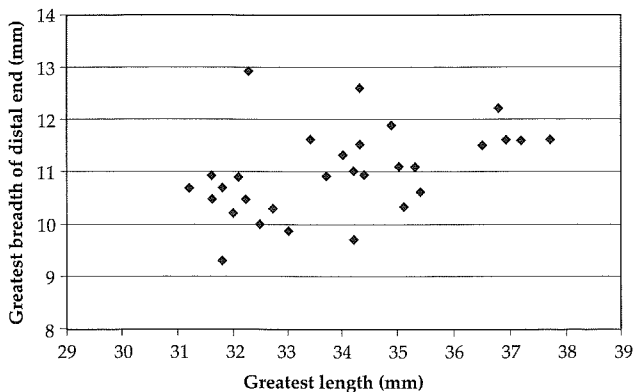|	Bird	Cat	Cow	Dog	Frog	Mouse	Pig	Sheep/goat
Skull	0	3	78	24	0	6	29	348
Teeth	0	0	96	2	0	0	74	375
Fore limb	1	2	17	14	1	5	27	221
Hind limb	9	1	10	7	4	19	12	87
Body	3	3	36	125	0	3	22	650
Feet	0	3	46	30	0	0	52	580
Other	4	0	7	12	54	107	2	37
Total	**17**	**12**	**290**	**214**	**59**	**140**	**218**	**2298**

Figure 11.15. *Size range of the first phalange of sheep.*

residuality between phases). On this basis it is calculated that at least 45 sheep/goat contributed to the deposit. Tentative study (see also tooth wear from Tarxien deposits below), suggests these were young animals, where third molars were unerrupted (Grant 1982) and fusion age in the order of 1–2 years (Silver 1969). The recovery of skeletal fragments was dominated by torso body parts (vertebrae, ribs, pelvis) followed by feet (phalanges, tarsals, carpals etc.) and then by skull, loose teeth and finally by limbs. These figures in their uncorrected state (for fragmentation) provide a baseline for comparison with contributions to the deposit by individual phases (Table 11.5). No positive evidence for goat was noted. On 30 specimens (excluding those from agricultural levels) it was possible to take take measurements on the first phalange and these are presented here in graphical form (Fig. 11.15).

11.2.3.2. Cow
Cow was the second largest identifiable constituent part of the assemblage (290 - 4.2 per cent) as measured on number of identified fragments, although substantially less numerous than sheep/goat. It is calculated that at least fourteen cows contributed to the deposit, placing the species below pig (see below). The recovery of skeletal fragments differed from sheep since it was dominated by loose teeth followed by skull followed by feet (phalanges, tarsals, carpals etc.), torso body parts (vertebrae, ribs, pelvis) and finally by limbs. There were insufficient numbers to make a statistically valid set of measurements on individual skeletal parts

11.2.3.3. Pig
Pig was the third largest identifiable constituent part of the assemblage (218 - 3.2 per cent) as measured on number of identified fragments, although the calculation of fifteeen pigs places the species as second most frequent to sheep. The recovery of skeletal fragments differed from sheep and cow since it was dominated by loose teeth followed by feet (phalanges, tarsals,

Table 11.6. *Presence of identified fragments by species and period.*

	Bird		Cat		Cow		Dog		Frog		Mouse		Pig		Sheep/goat		Total
Żebbuġ	0	0.0%	0	0.0%	2	9.1%	0	0.0%	0	0.0%	0	0.0%	1	4.5%	19	86.4%	**22**
Żebbuġ (Ġgantija)	0	0.0%	0	0.0%	2	7.4%	0	0.0%	0	0.0%	0	0.0%	1	3.7%	24	88.9%	**27**
Tarxien (Żebbuġ)	0	0.0%	0	0.0%	1	7.7%	0	0.0%	0	0.0%	0	0.0%	1	7.7%	11	84.6%	**13**
Tarxien	28	1.3%	12	0.6%	194	8.8%	9	0.4%	57	2.6%	140	6.4%	143	6.5%	1611	73.4%	**2194**
Rock fall	0	0.0%	0	0.0%	14	14.9%	0	0.0%	0	0.0%	0	0.0%	14	14.9%	66	70.2%	**94**
Tarxien Cemetery	1	0.35%	0	0.0%	36	12.6%	1	0.35%	0	0.0%	0	0.0%	28	9.8%	220	76.9%	**286**
Borġ in-Nadur	0	0.0%	0	0.0%	4	2.4%	3	1.8%	0	0.0%	0	0.0%	2	1.2%	159	94.6%	**168**
Bayer	0	0.0%	0	0.0%	20	6.3%	200	63.1%	2	0.6%	0	0.0%	19	6.0%	76	24.0%	**317**
Agricultural	0	0.0%	0	0.0%	8	8.9%	1	1.1%	0	0.0%	2	2.2%	5	5.6%	74	82.2%	**90**
Unstratified	0	0.0%	0	0.0%	9	17.7%	0	0.0%	0	0.0%	0	0.0%	4	7.8%	38	74.5%	**51**

carpals etc), followed by skull , and then fore limb and only then torso body parts (vertebrae, ribs, pelvis) and hind limbs. There were insufficient numbers to make a statistically valid set of measurements.

11.2.3.4. Dog

Dog was an insignificant presence in the prehistoric deposits comprising only 89 fragments with a probable minimum number of four individuals. Dog appears to have been the size of a medium-sized collie. All the statistics are dominated by the deliberate burial of a young male adult dog at the bottom of the Bayer excavation in the nineteenth century AD bringing the total fragments up to 214.

11.2.3.5. Mouse

Mouse was a small but significant presence comprising 142 identified specimens from at least seven individuals. Young animals appear to predominate which may indicate predation by owls, but this interpretation needs further analysis.

11.2.3.6. Frog

Frog was an even smaller but significant presence comprising 59 identified specimens from at least four individuals.

11.2.3.7. Bird

Birds comprised 29 identified specimens from at least four individuals. These were small- or medium-sized species.

11.2.3.8. Cat

Cat was a small presence comprising 12 identified specimens from at least three individuals, with at least two adults and one young individual.

11.2.3.9. Absent species

The three major domestic species are present, but it is worth considering the species that are absent from

Table 11.7. *Distribution of sheep/goat skeletal parts for three principal periods (71 per cent head and feet in Tarxien Cemetery).*

	Żebbuġ + Żebbuġ (Ġgantija)		Tarxien		Tarxien Cemetery	
Skull	22	51.2%	232	14.4%	39	17.7%
Teeth	15	34.9%	204	12.7%	72	32.7%
Fore limb	0	0.0%	144	8.9%	28	12.7%
Hind limb	0	0.0%	69	4.3%	3	1.4%
Body	4	9.3%	532	33.0%	29	13.2%
Feet	1	2.3%	415	25.8%	45	20.5%
Other	1	2.3%	15	0.9%	4	1.8%
Total	**43**		**1611**		**220**	

Table 11.8. *Distribution of cow skeletal parts for two principal periods (80.5 per cent head and feet in Tarxien Cemetery).*

	Tarxien		Tarxien Cemetery	
Skull	63	32.5%	3	8.3%
Teeth	46	23.7%	23	64.0%
Fore limb	9	4.6%	3	8.3%
Hind limb	8	4.1%	0	0.0%
Body	32	16.5%	1	2.8%
Feet	33	17.0%	3	8.3%
Other	3	1.6%	3	8.3%
Total	**194**		**36**	

Table 11.9. *Distribution of pig skeletal parts for two principal periods (92.8 per cent head and feet in Tarxien Cemetery).*

	Tarxien		Tarxien Cemetery	
Skull	15	10.5%	6	21.4%
Teeth	45	31.4%	12	42.8%
Fore limb	22	15.4%	1	3.6%
Hind limb	10	7.0%	0	0.0%
Body	17	11.9%	1	3.6%
Feet	32	22.4%	8	28.6%
Other	2	1.4%	0	0.0%
Total	**143**		**28**	

these deposits. The absence of wild species (with the exception of cat (?)) is notable. Furthermore the absence of marine resources (in spite of the presence of decorative shells and cuttlefish) is another point of note, a conclusion that is corroborated by isotopic analysis (Richards *et al.* 2001; §11.3). As an aside, it is worth reiterating the sampling strategy. A good sample of the different deposits were floated and wet-sieved for molluscan samples in upper levels of the site (Chapter 2), so although further work at the Circle would need to check these results they do provide a provisional result which caters for the presence/absence of small bone fragments.

11.2.4. Chronological change (Tables 11.6–11.9)
11.2.4.1. Żebbuġ
Interpretation of the pure Żebbuġ deposits is dominated by the intact Żebbuġ rock-cut tomb. Only 22 fragments of animal bone identifiable to species were recovered and these consisted entirely of the three major domestic species dominated by sheep/goat. No bone was gnawed, cut or burnt. The selection of skeletal parts was substantially skewed towards the head. It is quite clear there was ritual practice that placed a trophy sheep head within the funerary deposit.

Specific Żebbuġ-influenced deposits
Puppy burial near the west niche (671)
The modest amount of animal bone (NISP = 89) in the niche has a lower recognition rate to species level (35.6 per cent) than the average for Tarxien deposits (51.58 per cent) which is some indication of its higher fragmentation. Compared with other deposits, the animal bones are similarly dominated by sheep/goat (75 per cent of identified fragments) where skull/mandible/teeth fragments, but also some feet and torso parts dominate the assemblage. This may be suggestive of an animal pelt (retaining the head and feet) placed over the human remains. Ageing, where available, suggested more mature animals. There were also limited fragments of cow and pig (NISP = 8). The fact that the cow fragments are also from the mandible gives extra credence to the idea that this is principally a trophy-head deposit accompanying the burial. The puppy burial itself was identified *in situ* by the faunal analyst as aged between two and six months, according to tooth eruption (Silver 1969), but was too fragmentary to be recorded as part of the faunal statistics.

Flint knife burial in (731) near the west niche
The deposit (731) contained a modest amount of animal bone (NISP = 74) with a higher recognition rate to species level (60.81 per cent) than the average for Tarxien deposits (51.58 per cent) which is some indication of its lower fragmentation. Compared with other deposits, the animal bone is similarly dominated by sheep/goat (71.11 per cent of identified fragments) where teeth, skull and torso body parts predominate, and where there is greater evidence for older animals. The most notable feature of the deposit is the relative frequency of cow (22.2 per cent), as well as more limited fragments of dog and pig (NISP = 3).

Żebbuġ (Ġgantija)
The west chamber of the Żebbuġ rock-cut tomb was re-entered during the Ġgantija phase and the animal bones associated with this phase have almost exactly the same characteristics as the early deposits in the west niche. Only 27 fragments of animal bone were recovered, and these are also dominated by sheep/goat and trophy heads.

11.2.4.2. Tarxien
The Tarxien assemblage is the richest of all the phases, comprising elements of all represented species. The three major domesticates (sheep/goat, cow and pig) dominate, although mice are also present in relatively large quantities. Only two fragments of bone appear to have been gnawed, and only two had visible cut marks. Less than 0.5 per cent of the bone had been burnt. Sheep/goat (1611 identified fragments (73.4 per cent), MNI = 19 (42.2 per cent)) comprises the most prominent species with an emphasis on the young and foetal in terms of epiphyseal fusion and relatively young (grades C–F (six months to four years)) in terms of tooth wear (Payne 1973). There is a balance in the choice of sides of the body (273:273). The older age of teeth may represent the selection of older trophy heads as part of the ritual, whereas offerings of foetal remains is clearly part of the same ritual process. This will be examined in more detail in individual contexts. The presence of skeletal parts reflects this multiple ritual process, showing a composite effect. Cow (194 identified fragments (8.8 per cent), MNI = 4 (8.8 per cent)) comprises the next most prominent species although little different from pig. There was too small a sample to make any conclusion on tooth wear, but epiphyseal fusion suggests a strong presence of young and to a lesser extent foetal animals. There is a similar composite pattern of skeletal parts, although with greater prominence of the head. Pig (143 identified fragments (6.5 per cent), MNI = 5 (11.1 per cent)) has a very similar profile to cow. There is a similar composite pattern of skeletal parts, although with greater prominence of teeth. Mouse (140 identified fragments (6.4 per cent), MNI = 6 (13.3 per cent)) and frog (57 identified fragments (2.6 per cent), MNI = 3 (6.6 per cent)) are found almost exclusively in the Tarxien deposits. Bird (28 identified fragments (1.3 per cent), MNI = 3 (6.6 per cent)) is also found almost exclusively in the Tarxien deposits and comprises mainly small birds. Cat (12 identified fragments (0.5 per cent), MNI = 3 (6.6 per cent)) is found exclusively in the Tarxien deposits and includes at least two adults and one juvenile.

Specific Tarxien deposits
Some individual contexts or sequences/collections of deposits deserve special attention for the quantity or configuration of material.

Deep sounding into North Cave (132, 135)
The animal bone, although relatively numerous (NISP = 330), is highly fragmented due to crushing and compression with a recog-

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nition rate to species of less than 25 per cent. Compared with other deposits, the animal bones are even more disproportionately dominated by sheep/goat (88.75 per cent of identified fragments) where torso body skeletal parts (ribs, vertebrae and pelvis) and young animals (on the basis of fusion) dominate the assemblage. There were also limited fragments of pig, cow and dog (NISP = 9).

North Threshold bone pit (354, 622, 623, 669, 697, 799)
The northern Threshold pit is a highly significant burial pit at the entrance to the site which is described elsewhere in terms of its stratigraphy, cultural content and human bones (§8.1.3.1). Although it can be argued that temporally distinct groups of ancestors constitute the human deposits, it seems very probable that the deposit was formed over a short period incorporating animals from one source. On this basis the animal bones are considered from both the perspective of one grouped deposit — particularly for the calculation of MNI, and as a base line for an understanding of the distribution of skeletal parts throughout the pit, and from the perspective of the individual layers. The sequence, once integrated with other evidence, may cast light on the process of the funerary ritual.

As a group these animal bones comprise one of the large samples from the Circle (NISP = 1099), albeit from a very fragmented deposit where less than 25 per cent is recognizable to species level. The group is even more substantially dominated by sheep/goat (83.96 per cent), with only small contributions from cow (10.82 per cent) and pig (5.22 per cent). This proportion is only slightly varied by the calculation of MNIs, with contributions from as many as nine sheep (75 per cent), two pigs (16 per cent) and one cow (8 per cent). The most prominent sheep skeletal parts are left humeri (as many as eight adults and one young animal), left astragali (three individuals), left calcanea (four individuals) and thorassic vertebrae (four individuals). The prominence of some key meat-bearing bones (e.g humeri), feet and torso (e.g. vertebrae) is confirmed by the overall distribution of body parts for fore limbs (13.78 per cent), feet (22.22 per cent) and torsos (39.11 per cent). The prominence of left-handness is confirmed by the overall statistics of 66 (64.71 per cent) to 36 (35.29 per cent) sided skeletal parts. Among the sheep, there appears to be a broad distribution of age between adult and young (but not foetal).

Against this baseline for the deposit as a whole, the bottom layer (799) in association with the flexed human burial, has a greater emphasis on sheep (87.5 per cent) with torso body parts (51.79 per cent) and younger individuals which show no preference for sidedness. There is an increasing emphasis on left-handedness in the upper layers (reaching 66.67 per cent) in the upper deposit around the human skulls. The quantity of bone varies between a few (12 in (623)) to larger amounts (383 in (697)) and the proportion of sheep from 72.41 per cent to 93.75 per cent.

East Cave central surface pit (714, 425, 738) (§8.1.3.2)
This pit contained a modest sample of animal bone (NISP = 135) but has a higher recognition rate to species level (65.19 per cent) than the average for Tarxien deposits (51.58 per cent), which is some indication of its lower fragmentation. Compared with other deposits, the animal bones are even more disproportionately dominated by sheep/goat (81.82 per cent of identified fragments) where torso body parts (especially pelvis) and skull fragments (including horn cores) dominate the assemblage. The MNI of four sheep is registered by the presence of four left mandibles. There were also limited fragments of cow, pig and dog (NISP = 16) where the cow skeletal parts are dominated by skull fragments, especially horn cores. There is clear evidence that this deposit is dominated by trophy-head offerings accompanying the burials.

East Cave southern surface pit (715/509) (§8.1.3.3)
The pit contained a small amount of animal bone (NISP = 40) and is characteristically dominated by sheep/goat (85.71 per cent of identi-

fied fragments) where hind limbs (femora) and feet predominate. The most interesting aspects of this deposit are the presence of a few meat-bearing bones (femora from at least two animals) and, albeit on a very small sample, the tendency towards right-handedness (6:3). There were also some cow feet fragments.

South Cave burial (704) (§8.5.4)
The South Cave produced a modest amount of animal bone (NISP = 156) with a higher recognition rate to species level (60.26 per cent) than the average for Tarxien deposits (51.58 per cent) which is some indication of its lower fragmentation. Compared with other deposits, the animal bones are even more disproportionately dominated by sheep/goat (85.11 per cent of identified fragments) where skull fragments including horn cores and young animals (on the basis of fusion) dominate the assemblage. There were also limited fragments of cow, pig, bird and dog (NISP = 14). There is clear evidence that this deposit is dominated by a trophy-head offering accompanying the burial.

South Cave burial northern sector (766) (§8.5.4)
This deposit contained a small amount of animal bone (NISP = 22) but has a very high recognition rate to species level (81.82 per cent), suggesting a low level of fragmentation. Compared with other deposits, the sample is less dominated by sheep/goat (55.56 per cent of identified fragments) and there is no strong pattern of skeletal parts or age. There were also limited fragments of cow, mouse and pig (NISP = 8).

East Cave southwest burial niche (595, 596) (§8.4.2.6)
These relatively small deposits (NISP = 20, 47) were dominated by sheep/goat (84.62–92 per cent), torso (vertebra/pelvis) (595) and mandibles and meat-bearing fore limbs (596). There is also a significant proportion of young animals. Cow and pig were also present in small quantities.

Display zone (783) (§8.3.2)
The sample from the large burial deposit (783) represents a modest amount of animal bone (NISP = 192), particularly in the context of a large amount of human bone extracted from the same deposit. The deposit is nevertheless diverse (containing bird, cat, cow, pig and sheep) with a high recognition rate to species level (68.23 per cent). This diversity has led to a smaller proportion of sheep/goat (65.65 per cent) where skeletal parts were dominated by feet as well as some significant meat-bearing bones (radius/ulna). Right-handedness (29:16) and the number of young and foetal body parts are high. The presence of the major domesticated species is modest (NISP = 15), although the presence of a whole cow scapula (possibly employed as a digging tool for the repackaging of bones) should be noted.

Betyl deposit (830) (§8.4.2.2)
The (830) deposit contained a very modest sample of animal bone (NISP = 39) but with a higher recognition rate to species level (74.36 per cent) than the average for Tarxien deposits (51.58 per cent) which is some indication of its lower fragmentation. The animal bones are disproportionately dominated by sheep/goat (75.86 per cent of identified fragments), where torso (especially vertebrae), feet (right calcaneum gives a MNI of 3) and forelimbs (radius/give a MNI of 3), have a fairly marked right-handedness (29:16). However the MNI of two sheep is registered by the presence of two right humeri, suggesting some meat-bearing component. There was also a prominence of young and foetal remains. The limited fragments of cow and pig (NISP = 7) included a cow pelvis.

Betyl deposit (926) (§8.4.2.4)
The deposit (926) has an equally modest sample of animal bone (NISP = 38) and an identification rate to species level (50 per cent)

similar to the average for Tarxien deposits (51.58 per cent). The animal bones are disproportionately dominated by sheep/goat (73.68 per cent of identified fragments) where feet and teeth/mandible fragments dominate the assemblage. Other species comprised limited fragments of bird, cow and pig (NISP = 5).

Burial deposit (1241) (§8.4.2.4)
This deposit contained a small amount of animal bone (NISP = 52) with a very high recognition rate to species level (84.62 per cent) compared with the average for Tarxien deposits (51.58 per cent) which is some indication of its lower fragmentation. Even compared with other deposits, the animal bones are very much dominated by sheep/goat (90.91 per cent of identified fragments) where feet (MNI of 2 from left metatarsal and right calcaneum), torso (MNI of 2 from pelvis), upper limb (MNI of 3 from left humerus) and skull (including horn core) are prominent features of the assemblage. There were a number of fragments of mouse and pig (NISP = 4). This appears to be a mixed deposit that includes some deliberate skull deposition, but also meat-bearing and rubbish deposits, and might be a candidate for the presence of a pelt (with skull and feet) covering the funerary deposit.

North niche (845) (§8.2.3)
This niche deposit contained the largest amount of animal bone encountered in the Circle (NISP = 596) in one context and it is accompanied by a fairly high recognition rate to species level (76.85 per cent) compared with the average for Tarxien deposits (51.58 per cent) which is some indication of its lower fragmentation. Even when compared with other deposits, the animal bones are very much dominated by sheep/goat (90.61 per cent of identified fragments) where spinal fragments (MNI of 14 from thoracic vertebrae and 9 from caudal vertebrae), feet and meat-bearing bones (femora, tibia, pelvis, radius) are prominent features of the assemblage. There were a number of fragments of frog, cat, cow, dog, mouse and pig (NISP = 43). A fair proportion of the sheep and pigs appear to be of a young age. There is no evidence for sidedness. We can perhaps interpret this deposit as the residue of a distribution of body parts to other destinations, leaving behind the central and peripheral vertebrae in disproportionate number.

Dump deposits (951/933) (§8.2.4)
The dump deposits contained a small quantity of animal bone (NISP = 37). This is a modest component of a larger deposit of human bone, interpreted elsewhere as a secondary deposit of human bone. The lack of animal bone and the high identification rate (75.68 per cent) may be further evidence of the secondary nature of the deposit. The animal bones are substantially sheep/goat (75 per cent) where the skeletal parts are dominated by torso (particularly vertebrae) and fore limbs. There was some cow and pig (NISP = 7).

Deep deposit (1144, 1220) (§8.2.4)
This stratigraphically deeper deposit is more diverse in terms of its human-bone content than most contexts, but still has a relatively small (NISP = 119). The presence of frog (NISP = 31) may be indicative of the seasonally damp conditions of this part of the site. If this species is excluded, the deposit is characteristically dominated by sheep/goat (86.20 per cent) and represented principally by vertebrae fragments. There are traces of bird, pig, cow and mouse (NISP = 8).

Discussion
If we consider these deposits to be derived from the ritual process of the funerary site, we can hazard an interpretation of how they fit together. Zones such as (845) may represent mainly the residue of animal offerings that are distributed elsewhere. Other dense deposits appear to be pit deposits mainly on the surface level of the site. Some show a prominence of meat-bearing bones and some

show deliberate trophy-head qualities. In some cases these can be associated with human qualities of gender and even identity. Others show a separation according to principles of handedness and laterality. Another explanation for some animal parts is their use in the mode of a shroud or body covering. The preponderance of heads and feet could suggest that whole animal skins still attached to head and extremities were used as shrouds over some bodies. This practice has been indicated in long barrows in Britain (Ashbee 1966; 1984), and in the absence of other coffins, shrouds or coverings, is a possible explanation for these non-meat-bearing bones to be so well represented in the Circle.

11.2.4.3. Bronze Age and later deposits
Tarxien Cemetery
The Tarxien Cemetery assemblage is by contrast much more of a 'monoculture' where sheep/goat is even more dominant amongst an already domesticated assemblage. Sheep/goat (220 identified fragments (76.9 per cent), MNI = 7 (53.8 per cent)) is once more the most prominent species. Tooth wear is concentrated on wear states E–F (Payne 1973), suggesting a greater prominence of more mature animals (two to four years old), and this is confirmed by a more developed state of epiphyseal fusion. Cow (36 identified fragments (12.6 per cent), MNI = 2 (15.3 per cent)) comprises the next most prominent species although little different from pig. Pig (28 identified fragments (9.8 per cent), MNI = 2 (15.3 per cent)) is almost indistinguishable in representation. The skeletal parts represented in the major domesticated species all suggest a rubbish deposit of discarded extremities, conforming to a pattern of intermixed domestic refuse indicated by the micromorphological analysis (Chapter 9). The proportion of head and feet parts ranges from over 70 per cent (sheep/goat) to over 90 per cent (pig). As already remarked (see above) there is a higher presence of abrasion on individual fragments, but low rates of gnawing (two fragments), cut marks (one recorded) and burning (1 per cent). There is one presence each of dog and bird.

Borġ in-Nadur
The main distinguishing feature of the Borġ in-Nadur phase is the even greater dominance of sheep in the deposit (159 identified fragments comprising 94.6 per cent of the sample).

Bayer
The Bayer deposit can be probably interpreted as a selective sorting of the larger domestic species drawn from the ancient deposits. The most prominent feature is, however, the presence of an articulated young adult male dog at the lower limit of the Bayer excavation, placed there before backfilling.

11.3. Diet and environment in Maltese prehistory: results and potentials of a stable isotopic perspective on the Circle (LL, TOC, RHT)

11.3.1. Introduction
Understanding of the subsistence economy of early Malta and its impact on the inhabitants potentially may inform on wider issues of social complexity and change. In this section, we examine the provisional results from a study of stable isotopy, with the aim of assessing future research programmes. This work complements previous stable isotopic data by focusing on bone collagen, which reflects protein consumption (Richards *et al.* 2001), and adds the component of bone

mineral. The latter provides the isotopic signature of the whole diet, and integrates climatic factor into the wider picture through oxygen isotopic values. These studies show the great potential of a future, extensive sampling programme, including both collagen and apatite samples (human, animal and ideally vegetal) taken from the chronological phases of the site. The available faunal remains of cattle, pig and sheep/goat provide a partial picture of the prehistoric economy, although the ritual and funerary character of this and other Maltese sites means that they do not necessarily represent the domestic economy. Hints of other fauna are provided through art images, such as fish (Buġibba: Bonanno 1986b, 28–30) and curious reptilian creatures, but the research carried out by Richards and colleagues (2001) seems to indicate categorically, that marine fish or molluscs were rarely, if ever, on the menu during the Temple Period and that no significant intake of foods of marine origin were eaten. The opportunities to explore stable isotopy in this large population over several centuries of development might reveal if there were economic changes over time, and whether there was greater reliance on marine foods, climatic adaptations, or indeed, climatic change. Additional data might include gender difference in diet and social aspects that relate to food. To answer these questions a well-designed and extensive sampling is necessary in the future, but initial study of four individuals from the Circle shows preliminary results from isotopic analyses of bone collagen and apatite. Together with the isotopic data generated as part of the radiocarbon-dating program (see Chapter 12), this study adds data to the first study by Richards and colleagues that approached the economic patterns of the Circle's people isotopically.

11.3.2. Principles of isotopic analysis

The use of stable isotopes for dietary analysis has been applied to studies of human and animal subsistence in various geographic locations and time periods throughout prehistory (Ambrose *et al.* 1997; Balasse *et al.* 2002; Richards & Hedges 1999a). The foundation of isotopic research is based on the principle that 'you are what you eat' — that is, the various tissues in an animal's body are derived from its dietary intake.

Carbon stable isotope analysis is generally used to reveal information about the ecological foundation of an individual's diet — for example, marine versus terrestrial ecosystems (Schoeninger *et al.* 1983) or C_3 versus C_4 ecosystems (Pate 1995). Of the two main types of terrestrial ecosystems, C_3 and C_4, only the first seems to have been relevant in prehistoric Europe before the Late Bronze–Iron Ages. Nitrogen stable isotopes reflect the position of an individual in the food chain, since an individual's body tissues

show an increase in nitrogen isotopic values relative to diet (Minagawa & Wada 1984; Schoeninger & DeNiro 1984). Nitrogen isotope ratios can also be used to identify the consumption of aquatic (marine and freshwater) foods, since the nitrogen isotope values of most aquatic animals exhibit significantly enriched $\delta^{15}N$ values relative to terrestrial animals — a phenomenon that is probably due to the considerably longer length of aquatic food chains relative to land-based food chains. Although various protein sources can be differentiated using stable isotopic analysis, it is impossible to distinguish between dietary protein sources derived from the same animal (e.g. cow meat and milk); nor is it possible to assess the quality of the protein consumed, since all secondary products derived from an animal have the same isotopic profile as the meat of that same animal (Minagawa 1992; O'Connell & Hedges 1999). Environmental factors can affect the whole ecosystem, particularly with regard to nitrogen isotopes (Ambrose 1991; Schwarcz *et al.* 1999), so that the safest way to link rungs of the food chain is to have isotopic values of both, rather than basing an interpretation on human values alone.

As regards notation, stable isotope concentrations are measured as the ratio of the heavier isotope to the lighter isotope ($^{13}C/^{12}C$, $^{15}N/^{14}N$, $^{18}O/^{16}O$) relative to an internationally defined scale, VPDB for carbon, AIR for nitrogen and VSMOW for oxygen (Hoefs 1997). Isotopic results are reported as δ values ($\delta^{13}C$, $\delta^{15}N$, $\delta^{18}O$) in parts per 1000 or 'permil' (‰) values, where $\delta^{15}N_{AIR} = [(^{15/14}N_{sample} / ^{15/14}N_{AIR}) - 1] \times 1000$.

Although the mechanisms regulating isotopic fractionation between diet and body tissues are complex and not fully understood (Hedges 2003), we know that bone collagen primarily reflects the protein portion of the diet, because it is mainly synthesized from ingested protein (Ambrose 2000; Ambrose & Norr 1993). Bone apatite is a more comprehensive signal of diet since it is produced from proteins, carbohydrates and lipids (Ambrose & Norr 1993; Tieszen & Fagre 1993). This means that if there is no nutritional imbalance (Schwarcz 2000), collagen in humans will mostly reflect foods of animal origin, rich in protein, and will reflect plants only if animal sources of protein were scarce. Bone is remodelled throughout life, so collagen and apatite reflect the average isotopic composition of an individual's dietary intake over a period of years (Stenhouse & Baxter 1979): we can therefore assess the quantity of the different components of a standard diet, as long as they can be distinguished clearly from one another, and benefiting from several integrative sources of information, such as faunal and botanical remains, material culture, and organization across the landscape.

Owing to physiological factors associated with tissue synthesis, as well as differential representation of different foodstuffs in different tissues, we must consider the 'isotopic offsets' between dietary intake and the body tissues. In bone which archaeologically is the most important tissue because of its ubiquity, collagen $\delta^{13}C$ values are higher than the diet by about +5‰, and apatite $\delta^{13}C$ are about +12‰. From average plant values of –26‰ in a typical C_3 ecosystem, herbivore bone collagen is about –21‰, and bone apatite around –14‰. There is little change going up the food chain, so human values within C_3 ecosystems are typically around –19‰ (collagen) and –14‰ (apatite), with variation related to ecosystem-wide environmental factors (van Klinken et al. 1994), to the extent of their carnivory (Ambrose 1993; Schwarcz 2000) and also to differences in the source of carbohydrates and lipids.

Nitrogen isotopic values increase typically by +3–5‰ per trophic level (step in the food chain). In the terrestrial environment, nitrogen is fixed or absorbed by plants, and as the plant signature ($\delta^{15}N$ 0–4‰), is passed on up the food chain, typical herbivore values are about 4–8‰, and for carnivores about 8–12‰. Marine ecosystems, due to their much longer food chains, have a larger range of both $\delta^{13}C$ and $\delta^{15}N$ values. For super-predators, collagen values higher than $\delta^{13}C$ of –12‰ and higher than $\delta^{15}N$ of 15‰ have been documented, and the various fish taxa are somewhere in between these values and terrestrial ones (Richards & Hedges 1999b; Schoeninger & DeNiro 1984; Schoeninger et al. 1983).

Apatite $\delta^{18}O$ is a proxy for the climatic conditions at the time of tissue formation. Oxygen isotopes are generally correlated to both local temperature and local precipitation. Specifically, the correlation between biogenic $\delta^{18}O$ in phosphates and carbonates on one hand, and meteoric water $\delta^{18}O$ values on the other, has been shown of several organisms and particularly large mammals that are obligate drinkers (Koch 1998; Kohn & Cerling 2002), so we can use the oxygen isotopic signature in human bone as a proxy to the atmospheric signature, through the steps of rainwater and drinking water (Longinelli 1984; Stephan 2000). These values can be compared both with climatic trends documented in the western Mediterranean, and internally across different phases, to help detect evidence of past geographic and temporal variation in temperature and/or humidity (Kohn & Cerling 2002). This can also provide a surrogate means to interpret correctly the collagen $\delta^{13}C$ and especially $\delta^{15}N$ values, which have been shown to depend partially on water availability and precipitation (Schwarcz et al. 1999). Needless to say, this is more important only

if the direct measurement of bone from fauna across the food chain is not available: this remains the most accurate way of assessing ecosystem-wide shifts in isotopic values due to environmental factors.

11.3.3. Materials and methods

For this study we analysed four individuals, three adult (two males and one female) and one possible subadult. All the samples are Tarxien in date (c. 3000–2400 BC), but no absolute date has been obtained directly from them. The radiocarbon dates for the part of the hypogeum where the samples derive from tend toward the later part of this phase (c. 2700 BC onwards) and two (BR1 and BR4) are closely associated with the latest dates known for Tarxien anywhere in Malta (c. 2400 BC). The chronology of the four samples within this timespan is therefore extrapolated through stratigraphic relationships with the AMS-dated materials. This means it is probable but tentative, especially considering the practices documented in the burial, where earlier human remains were placed over more recent depositions.

Between 0.5 and 1 g of bone per each individual was removed and physically cleaned by sandblasting. After removal of 10 mg of bone for apatite analyses, collagen was isolated by demineralization with 0.5 M aq. HCl at 4°C, rinsed and gelatinized in pH 3 water at 75–83°C for 48 hours. The liquid portion obtained by filtration was then freeze-dried, and analysed. Samples were run in duplicate, and analyses were performed using an automated elemental analyser coupled in continuous-flow mode to an isotope-ratio-monitoring mass-spectrometer (Costech elemental analyser coupled to a Finnigan MAT253 mass spectrometer, Godwin Laboratory, Department of Earth Sciences, University of Cambridge). Based on replicate analyses of international and laboratory standards, measurement errors are less than ±0.2‰ for $\delta^{13}C$ and $\delta^{15}N$.

To isolate the apatite, 10 mg of bone powder are treated with a c. 72-hour bath in sodium hypochlorite to dissolve the organic portion; non-biogenic carbonate is removed by soaking the sample for c. 24 hours in a 1 M buffered acetic acid/sodium acetate solution (Koch et al. 1997). Bone apatite is less accurate and reliable if compared to collagen and particularly to tooth enamel, because of the risk of re-crystallization of exogenous carbonates leaked from the soil matrix into the bone, which may not be removed completely (Lee-Thorp & van der Merwe 1991; Nielsen-Marsh & Hedges 2000a). However, the reliability of bone apatite has been recently reassessed, showing that depending on the environmental conditions of the matrix, crystallization may in some cases even favour the preservation of isotopic signal in carbonate (Lee-

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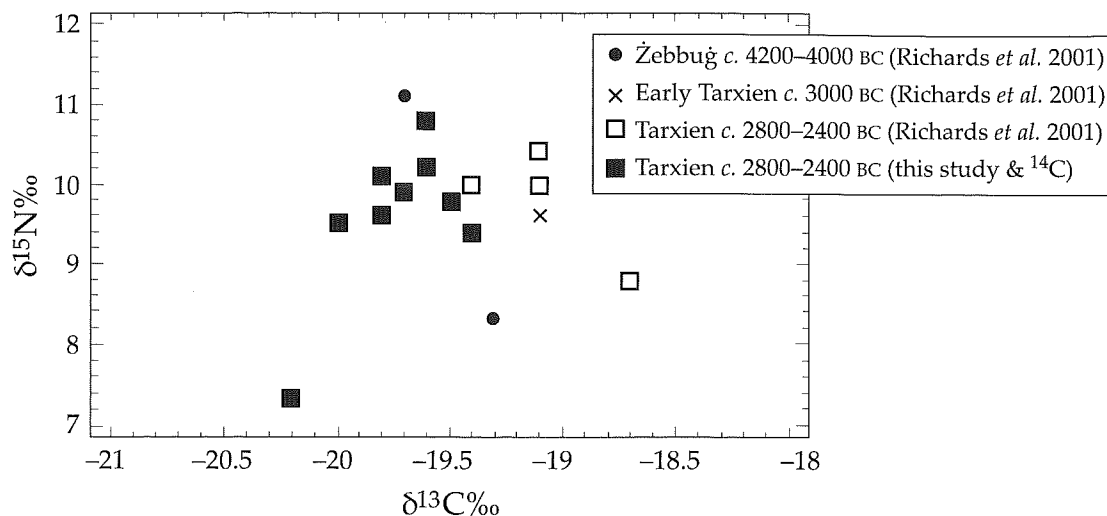
Figure 11.16. *All collagen $\delta^{13}C$ and $\delta^{15}N$ values from the Brochtorff Circle, including both the samples from Richards et al. 2001 and this study, with cultural-chronological phase indicated.*

Thorp & Sponheimer 2003). The protocol used and the assessment of the sample integrity through the yields (Nielsen-Marsh & Hedges 2000b) measured after each preparation treatment, besides the range of isotopic values themselves, can be used as a proxy for reliability. The purified apatite powder samples have been analysed by mass spectrometry at the University of South Florida facilities, St Petersburg campus. The contextual measurement of a control standard material (marble) insures the analytical reliability of the results. Precision (2σ) is typically better than ±0.04‰ for $\delta^{13}C$ and ±0.06‰ for $\delta^{18}O$ (Lai *et al.* 2007; Tykot 2004b, 436–8).

11.3.4. Results and discussion (see Table 11.10)
The reliability of collagen samples was assessed using standard parameters, such as collagen yield from whole bone, atomic C:N ratio and the quantity of N and C in collagen (Ambrose 1990; 1993). Three out of four samples produced good collagen, with yields between 2.1 per cent and 8.2 per cent and C:N ratio between 3.16 and 3.18, which is within the range considered an indicator of excellent preservation (2.6–3.4: Ambrose 1993). One individual, BR3, yielded very little collagen and, despite a C:N ratio still within

the aforementioned range, showed collagen C and N abundance in collagen and isotopic results out of the common human range. These collagen values are not considered reliable and therefore are not reported here.

These isotopic results on collagen have been combined with those generated in the radiocarbon-dating program (reported in Table 12.3) to expand the data set. The collagen isotopic ratios range between –20.2‰ and –19.4‰ for $\delta^{13}C$. The $\delta^{15}N$ values range between 7.3‰ and 10.8‰, with the majority clustered at the upper end of the range, and one outlier with a low $\delta^{15}N$ of 7.3‰. These isotopic values indicate a mainly terrestrial diet for these individuals, but in the absence of comparative fauna, we cannot be more specific than this. In the prehistoric Mediterranean, a similar interpretation has been suggested for several locations, both inland (Lai *et al.* 2007; Le Bras-Goude *et al.* 2006; Papathanasiou 2003; Richards *et al.* 2003; Tykot & Robb 1999; Tykot *et al.* in prep.) and coastal or insular (among others: Davis 2002; Papathanasiou 2000; Van Strydonck *et al.* 2002), as Gozo. In reality, we do not currently possess data concerning the isotopic signature of prehistoric fish in the Mediterranean, and this limits the detail of our potential conclusions. $\delta^{15}N$

Table 11.10. *Isotopic results.*

Sample no.	Context no.	Collagen		Collagen		Apatite	
		Yield %	C:N ratio	$\delta^{13}C$‰	$\delta^{15}N$‰	$\delta^{13}C$‰	$\delta^{18}O$‰
BR1	1241	2.1	3.17	–19.6	10.2	–14.3	–2.9
BR2	1254	4.7	3.16	–19.5	9.9	–9.1	–2.6
BR3	760	0.6	2.93	–18.9		–13.9	–3.2
BR4	960	8.2	3.18	–19.8	10.1	–10.0	–2.1
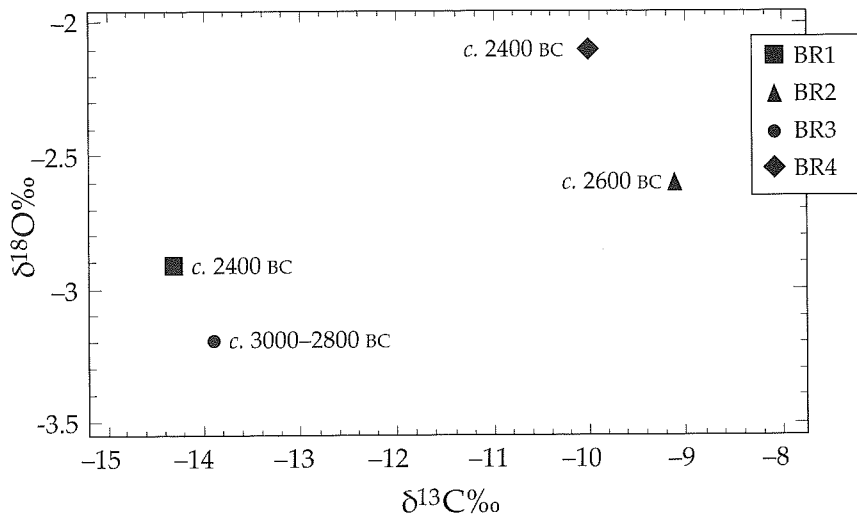
Figure 11.17. *Apatite $\delta^{13}C$ and $\delta^{18}O$ values from the Brochtorff Circle, with associated chronology from direct AMS radiocarbon dating.*

values, within 0.4‰, are as well within the range of most Mediterranean sites. They can be interpreted as reflecting a terrestrial origin of most protein intake.

The two Żebbuġ samples yielded quite different $\delta^{15}N$ values from each other, which implies a substantial difference in animal-protein consumption. However, both $\delta^{15}N$ and $\delta^{13}C$ values may reflect to some extent environmental variation, which we cannot assess without faunal samples. They are also higher and lower than the Tarxien phase group (excluding the Tarxien outlier with a low $\delta^{15}N$), so that no temporal trend can be identified.

Concerning the apatite results (Fig. 11.17), they range between −14.3‰ to −9.1‰ for $\delta^{13}C$ and between −3.2‰ and −2.1‰ for $\delta^{18}O$. For the reasons we mentioned above, apatite is not as routinely analysed as collagen, so that we do not have as large a body for comparison. Since it derives from the integration of all macronutrients, its signature reflects a variety of potential factors, and its interpretation is very complex: origin and relative proportion of protein, carbohydrates and lipids all contribute to the isotopic ratio that is found in bone mineral. The range of the Circle individuals spans most of the range documented for prehistoric sites in central and southern Italy (Tykot & Robb 1999; Tykot *et al*. in prep.), and Sardinia (Lai *et al*. 2007). Since the protein portion of the diet, according to $\delta^{15}N$ collagen values, was fairly similar among the four individuals, the variation likely depends on different sources and/or relative quantities of carbohydrates and/or lipids. Based on the foodstuffs we know were available to the prehistoric Maltese, a substantial contribution of C_4 plants, which would explain

the enrichment, is very unlikely: there is no evidence of C_4 crops until much later in prehistory. Additionally, we do not know the dietary role of carbohydrates and lipids from several fruits that might have become available in the late third millennium BC in the central Mediterranean (such as figs, which could be dried and stored, olives which are a source of fat that can be stored as well, and acorn meal-bread). On the other hand, a diet richer in animal fats would account for depleted values, since animal fats are approximately 5–6‰ lighter than protein.

The $\delta^{18}O$ values themselves do correspond to depleted mid- to late third-millennium values from Sardinia (Lai *et al*. 2007). Heavier values generally correspond to drier and/or warmer conditions, although the variation among the four values from the Circle span only 1.1‰. This may be due to the lower isotope ratios of coastal environments (see Longinelli & Selmo 2003), or to drier conditions that may have affected Malta more than Sardinia due to its lower latitude. The few values do not cluster in relation to chronology, age at death, or sex: $\delta^{13}C$ and $\delta^{18}O$ are lighter in BR1 and BR3, and heavier in BR2 and BR4. All plots (not reported in this paper) combining collagen $\delta^{13}C$ and $\delta^{15}N$ with apatite $\delta^{13}C$ similarly show BR2 and BR4 closer to each other than to BR1, unsurprisingly since the apatite $\delta^{13}C$ values are the most distinctive. The small sample of individuals makes any further interpretation inappropriate at this stage. A larger sampling of human and faunal samples from the same stratigraphic contexts is a necessary condition for the reliable identification of meaningful patterns.

11.3.5. Conclusions and perspectives

This study has evident limitations, mostly related to the small sample number. For collagen, we have a larger number of individuals but no faunal values to compare with, which limits our conclusions. For the apatite $\delta^{13}C$ values, the sample number is extremely small, and ideally more detailed botanical and faunal analyses should provide better clues as to how to read the isotopic evidence (although the lack of any botanical material from the Circle limits this particular study). Besides the biochemical mechanisms of isotopic fractionation that are still to be fully understood (Hedges 2003; Jim *et al.* 2004), it is necessary to develop, at the interface between archaeology and science, models that systematically account for all the possible outcomes of different combinations and relative proportions of food items, available in the specific time and space, which fit the recorded isotopic ratio. The wide variety of domesticated grains and legumes, tree crops, domesticated animals, wild animals, fruits, seeds and roots, and marine resources available in the western-central Mediterranean during the Neolithic, Copper and Bronze Ages should offer potential for understanding diet. However, to interpret reliably the $\delta^{18}O$ values we need as well a more consistent sample of the human population and contextual analyses of fauna from Malta.

With these premises, we can draw a few preliminary conclusions:

- The source of dietary protein for the Brochtorff individuals of Tarxien phase, as already shown by a previous study, was mostly or exclusively terrestrial, mainly meat and/or dairy, while marine resources had little or no nutritional importance.
- Within the Tarxien-phase individuals, the later individuals (*c.* 2500–2400 BC) may have relied on terrestrial protein even more than their ancestors (*c.* 3000–2600 BC), although the shift may be an artefact of ecosystem-wide environmental change, which can be verified in the future by analysing animal samples.
- There is a substantial dietary difference across the four individuals (apatite $\delta^{13}C$ spanning 5.2‰), which is not due to protein, and is probably to be attributed to a different origin and/or proportion of carbohydrates and/or lipid in the diet.
- Apatite $\delta^{18}O$ values may indicate some environmental variation, which may be interpreted, according to current information on climatic change during the third millennium in south-central Mediterranean, as different levels of aridity from BR3 (the oldest sample) to BR4.

The reliability of these interpretations is severely affected by small sample size, but we believe we have shown the insights that an isotopic approach are for the evaluation of the main models to reconstruct the history of the Circle people and the prehistoric Maltese during the Neolithic and the Temple Period.

11.4. Conclusions

The human- and animal-bone samples gathered from the Circle represent the first major study either of human or indeed, prehistoric animal populations during the Temple Period and its antecedents. The lack of comparative material hinders generalizing conclusions, but, nevertheless, the large sample sizes, the controlled and systematic collection procedures, the statistical analyses and the scientific studies move this important aspect of Maltese prehistory a step or two forward, and show the potential of future work. A more interpretative contextualized overview will be presented in Chapter 14.