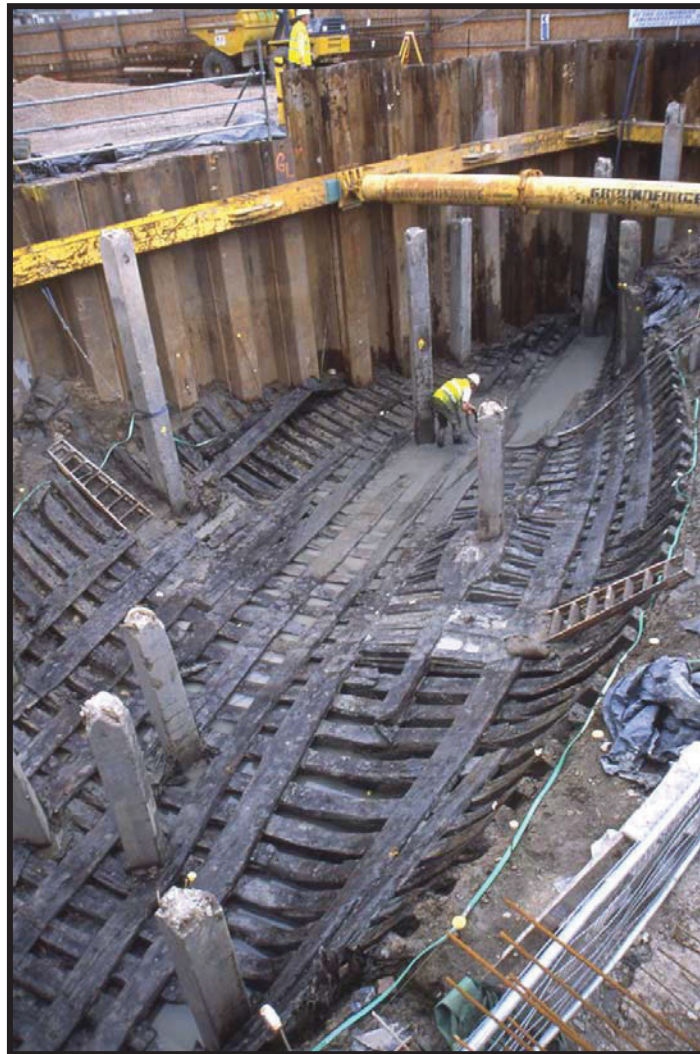


Newport Medieval Ship Project

Specialist Report:

HUMAN SKELETAL REMAINS



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University of Wales, Lampeter. March 2006.
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The Newport Ship Project

Introduction

In 2002, during the construction of the Riverfront Theatre, on the banks of the River Usk in Newport, South Wales, an archaeological find of great significance was unearthed. In the summer of that year, while undertaking the excavations for the theatre's orchestra pit, the well-preserved remains of a 15th century clinker built merchant vessel were discovered.

The site, which was surrounded by a cofferdam, was being monitored by the Glamorgan Gwent Archaeological Trust at the time of discovery. The ship lay in what is locally known as a pill or small inlet, with its stern closest to the river and its bow facing into the inlet. The timbers were covered in thick alluvial mud, which created an ideal anaerobic environment for successful preservation. Seventeen strakes of planking remained on the port side and thirty-five on the starboard side of the ship. The vessel was approximately 30m in length.

A silver French coin was found purposely inserted into the keel of the vessel, dating the ship to after May 1447. Dendrochronological research has shown the hull planking to be from the Basque country and after 1449 in date.

After a much publicised 'Save Our Ship' campaign, it was decided that the ship would not be recorded and discarded but excavated with the aim to conserve. The riders, stringers, braces, mast step, frames and overlapping clinker planks and keel were dismantled one by one and lifted. Almost 2000 ship components as well as hundreds of artefacts were excavated.

This report examines and lists the Human remains recovered during the Newport Medieval Ship excavation.

Brief Summary of the skeleton found during the Newport Ship excavations

By Dr. Ros Coard, University of Wales Lampeter

The Newport Body is a partial skeleton consisting of a headless upper torso and lower limbs which is truncated at the knees. Skeletal analysis shows that the Newport Body is a male, that he is a very muscular individual, especially in the upper arm region and is most probably right handed. The one surviving humerus is very muscular and bowed suggesting very strong upper arms which may be work related. The lower arm bones are less robust but still well developed. The individual could be described as 'robust' with a stocky physique with estimates of around 11-12 stone (70-80 kg.) and a height of 5'6" to 5'8" (172-176 cm.) in terms of stature and height.

There are difficulties in aging (years old at death) the individual as the many of the features of the skeleton used to age individuals are either no longer surviving or are poorly preserved. Thin sectioning of a segment of bone from the femur has been taken for the purpose of counting the osteons in the hope a better indication of his exact age at death can be determined.

The radiocarbon date places the Newport Body at the Late Iron Age/Earliest Romano British period. The Iron Age is known to be a time of ritual deposition into rivers and there are many archaeological examples of this. Interestingly from a British context it is mostly the heads that are recovered. The Newport Body is a rare example of body minus the head being recovered.

It was also noted that the surviving bone is remarkably well preserved with none of the expected and usual decay due to putrefaction. This suggests that he died and was buried very rapidly in an anaerobic environment where the natural bacteria were not able to take hold. The collagen (organic content of the bone) has survived well and may well indicate the extraction of DNA a distinct possibility. Radiocarbon dates suggest that the individual has no relationship with the Newport Ship and it would appear a fortuitous set of circumstances (as far as the archaeological community is concerned) that he should be buried so close to the ship and was recovered due to the excavation of it. Had he been a few metres further down stream he may have remained undiscovered. The body raises interesting questions for archaeology, fluvial taphonomy and forensic archaeology.

FROM: Darden Hood, Director (mailto:<mailto:dhoo@radiocarbon.com>)

(This is a copy of the letter being mailed. Invoices/receipts follow only by mail.)

October 10, 2005

Dr. Ros Coard
University of Wales
Department of Archaeology & Anthropology
Lampeter
Ceredigion SA48 7ED
Wales

RE: Radiocarbon Dating Result For Sample NEWPORTHUMAN

Dear Dr. Coard:

Enclosed is the radiocarbon dating result for one sample recently sent to us. It provided plenty of carbon for an accurate measurement and the analysis went normally. The report sheet contains the method used, material type, applied pretreatments and, where applicable, the two sigma calendar calibration range.

As always, this report has been both mailed and sent electronically. All results (excluding some inappropriate material types) which are less than about 20,000 years BP and more than about ~250 BP include this calendar calibration page (also digitally available in Windows metafile (.wmf) format upon request). Calibration is calculated using the newest (1998) calibration database with references quoted on the bottom of the page. Multiple probability ranges may appear in some cases, due to short-term variations in the atmospheric ¹⁴C contents at certain time periods. Examining the calibration graph will help you understand this phenomenon. Don't hesitate to contact us if you have questions about calibration.

We analyzed this sample on a sole priority basis. No students or intern researchers who would necessarily be distracted with other obligations and priorities were used in the analysis. We analyzed it with the combined attention of our entire professional staff.

Information pages are also enclosed with the mailed copy of this report. If you have any specific questions about the analysis, please do not hesitate to contact us.

Our invoice is enclosed. Please, forward it to the appropriate officer or send VISA charge authorization. Thank you. As always, if you have any questions or would like to discuss the results, don't hesitate to contact me.

Sincerely,

A handwritten signature in black ink that reads "Darden Hood". The signature is written in a cursive, flowing style with a large initial 'D'.

Dr. Ros Coard

Report Date: 10/10/2005

University of Wales

Material Received: 9/7/2005

Sample Data	Measured Radiocarbon Age	$^{13}\text{C}/^{12}\text{C}$ Ratio	Conventional Radiocarbon Age(*)
Beta - 208417	2060 +/- 40 BP	-20.8 o/oo $^{15}\text{N}/^{14}\text{N} = + 7.3 \text{ o/oo}$	2130 +/- 40 BP

SAMPLE : NEWPORTHUMAN

ANALYSIS : AMS-Standard delivery

MATERIAL/PRETREATMENT : (bone collagen); collagen extraction: with alkali

2 SIGMA CALIBRATION : Cal BC 350 to 300 (Cal BP 2300 to 2250) AND Cal BC 220 to 50 (Cal BP 2170 to 2000)

CALIBRATION OF RADIOCARBON AGE TO CALENDAR YEARS

(Variables: C13/C12=-20.8:lab. mult=1)

Laboratory number: Beta-208417

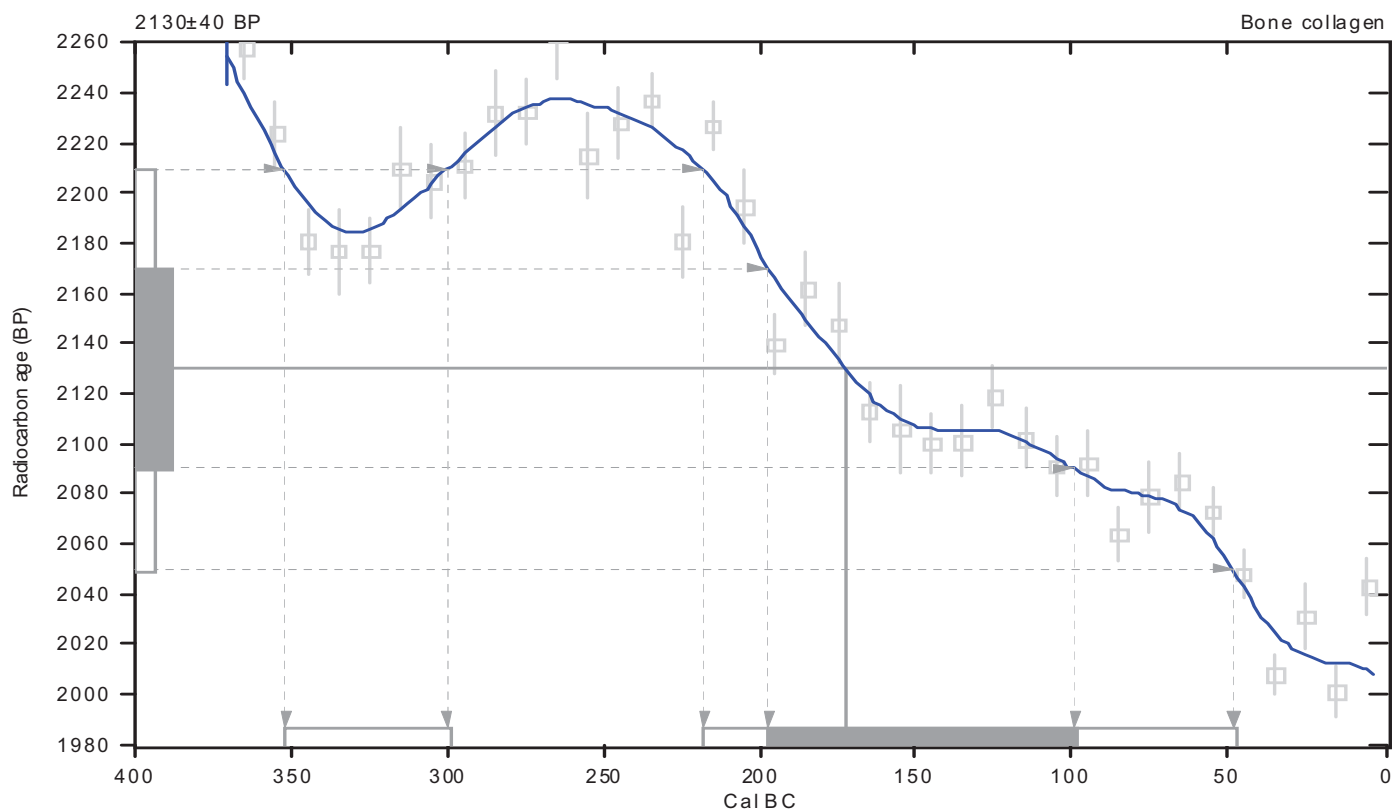
Conventional radiocarbon age: 2130±40 BP

**2 Sigma calibrated results: Cal BC 350 to 300 (Cal BP 2300 to 2250) and
(95% probability) Cal BC 220 to 50 (Cal BP 2170 to 2000)**

Intercept data

Intercept of radiocarbon age
with calibration curve: Cal BC 170 (Cal BP 2120)

**1 Sigma calibrated result: Cal BC 200 to 100 (Cal BP 2150 to 2050)
(68% probability)**



References:

Database used

INTCAL98

Calibration Database

Editorial Comment

Stuiver, M., van der Plicht, H., 1998, *Radiocarbon* 40(3), pxi-xiii

INTCAL98 Radiocarbon Age Calibration

Stuiver, M., et. al., 1998, *Radiocarbon* 40(3), p1041-1083

Mathematics

A Simplified Approach to Calibrating C14 Dates

Talma, A. S., Vogel, J. C., 1993, *Radiocarbon* 35(2), p317-322

Beta Analytic Radiocarbon Dating Laboratory

4985 S.W. 74th Court, Miami, Florida 33155 • Tel: (305)667-5167 • Fax: (305)663-0964 • E-Mail: beta@radiocarbon.com

Physical Anthropology and the Newport Skeleton: An Investigation into Robusticity, Handedness, Lifestyle and Activity Patterns with Particular Attention to the Arm Bones of the Newport Skeleton.

Hannah Goodall

Dissertation submitted in partial fulfilment of a B.A. (Hons.) in Archaeology and Anthropology, University of Wales Lampeter, March 2006.



(Photo courtesy of Newport City Council)

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Total Word Count (excluding Appendices & Bibliography) = 9,463

Abstract

Physical Anthropology is a biological science that studies human behaviour and culture human skeletal remains to do this. A unique opportunity to use physical anthropological methods to infer human behaviour arose with the discovery of the Newport skeleton, found under the medieval ship discovered on the banks of the River Usk at Newport. The Newport skeleton was assessed using physical anthropological techniques that are well defined and well researched in previous studies, and the results from this musculoskeletal assessment were used to infer activity patterns for the Newport individual. The assessment showed that the Newport individual was a tall, robust male whose possible activity patterns included regular and intense physical exercise and labour. These characteristics and suggested activity patterns have important uses in archaeology and anthropology and represent not a pattern or trend, but a unique individual.

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This dissertation would not have been possible without the help, support and advice of the following people: Matthew & Michelle Goodall, Andrew Hull, Lucy Trayner, Newport City Council & the Newport Ship project staff, staff at the National Library of Wales, Aberystwyth & the University of Wales Lampeter and last, but certainly not least, Dr Ros Coard for all her help, advice, proof-reading and support during the process of designing, researching and completing this dissertation. Thank you.

Chapter 1: An Introduction to the Newport skeleton and Physical Anthropology

During the final stages of the excavation of the Newport Ship, a medieval ship discovered on the banks of the River Usk in Newport, South Wales, a remarkable discovery was made: that of a human skeleton, uncovered when archaeologists were excavating the cradle supporting the ship.

The ship was discovered when excavations began for a new Arts Centre for the city. Following a highly publicised campaign to excavate and preserve the ship, described as “...probably more important than the Mary Rose...” (Barker 2001), £3.5 million was allocated to preserve the ships timbers.

The ship, believed to be Medieval in date, and possibly of Portuguese in origin, was thought to be berthed in Newport on a supporting cradle, indicating that the ship was berthed for repairs when it sank.

The skeleton was discovered underneath this supporting cradle, and the remains were compressed into a possible palaeochannel containing redeposited natural marl and clay (information courtesy of Kate Hunter, Newport City Council). The skeleton, which as of yet is not Radiocarbon dated, is in fair condition, although some of the smaller bones are crushed and quite badly damaged. The remains consist of approximately 43 bones including the lower arms, Pelvis, right and left Femurs and the left Humerus. The skull, unfortunately is missing as are the lower leg bones. The individual has no head, and is truncated at the knees.

There are two main possible theories about the Newport skeleton (thought to be male although this will be discussed later). The first theory is that the skeleton predates the ship and is possibly prehistoric, perhaps a burial or ritual killing. This theory is based on the fact that the bones are very large and robust looking, and were compressed into the mud underneath the supporting cradle of the ship. The second theory is that the skeleton is contemporary with the Newport ship, making the skeleton Medieval in date (Dendro

Other means of determining activity in the past include the excavation of sites and the interpretation of material culture left behind, for example, arrow heads. A study into the history of fishing in Africa by Inskeep (2001) discusses the possible methods throughout history, basing his observations both on material culture (e.g. spears, baskets, dug-out boats) and on analogies. In comparison to the large amounts of work carried out in these forms, skeletal material was used very little. It is only recently that more attention is being paid to skeletal material and the importance of it in reconstructing the past lives of populations/individuals.

Despite this, the continuing development of Physical Anthropology and the development of new scientific techniques, means that it is possible to tell much about an individual from their bones. Although much depends on the quality and level of preservation of the bones, and how much of the skeleton is found, a lot can be discovered about the individual's lifestyle: their diet, if they suffered from disease, whether they are male or female and their age (Cox & Mays 2002). Other studies have applied musculoskeletal analysis in order to suggest lifestyle and activity patterns in skeletal populations, for example Stirland's (1993) study of male skeletons found on the Mary Rose and Hawkey & Merbs's (1995) study of ancient Hudson Bay Eskimos.

There are two aims in this dissertation, the first being to use physical anthropological techniques to discover how far skeletal indicators, for example, muscle attachments, can be used to determine Robusticity and Handedness, with particular reference to the Newport Skeleton. Robusticity and Handedness are unique features which are of great interest as they tell archaeologists and anthropologists about the individual (Knüsel 2000; Steele 2000).

The second aim of this dissertation concerns the interpretation of evidence gained from the previous aim. In the case of the Newport Skeleton, to what extent can Physical Anthropology be useful in interpreting the lifestyle and activity patterns of the Newport skeleton? Who was he/she? What did they do in their life? Techniques such as Bone

measurements and the analysis of certain musculoskeletal markers will be used to assess the robusticity, handedness, lifestyle and activity patterns of the Newport skeleton.

This dissertation will use data gained from the musculoskeletal assessment of the Newport skeleton and compare the data (where applicable) to data gained from the Cwm Nash skeletal material (a late historical population housed at University of Wales Lampeter) in order to gain a picture of the Newport skeleton compared to other skeletal populations from Wales and to determine the use of musculoskeletal assessment in interpreting lifestyle and activity patterns in skeletal material.

It is the aim of this dissertation not only to use physical anthropological assessment to gain valuable musculoskeletal data about the Newport skeleton, but also to infer information about the individual, that is, the possible lifestyle and activity patterns of the Newport individual.

Chapter 2: The Methodology behind the musculoskeletal assessment of the Newport skeleton.

The first aim of this dissertation is to discover how useful skeletal indicators (for example, muscle attachments) are in determining robusticity and handedness, using the case study of the Newport skeleton. The second aim is to use the information gained from the Newport skeleton and attempt to interpret the lifestyle of the individual from his/her musculoskeletal markers.

Many studies into this area have been carried out and all these studies show that it is possible to infer past activities for groups based on musculoskeletal stress markers, but not individuals, and also show that there are many factors other than physical activity (e.g. diet, disease, trauma) to be considered when studying musculoskeletal stress markers. These studies examine the plausibility of the use of musculoskeletal markers in reconstructing the past lifestyles of populations and some highlight the reliability of such studies.

One such study links the development of the deltoid tuberosity to the “persistent action of a slingshot” (Fawcett 1935 in Stirland 1993:105). Specific activities have been linked to a single musculoskeletal marker in a study which suggested that a female skeleton was a laundress in life (Angel, Kelley & Parrington 1987 in Stirland 1993).

Stirland’s work also highlights the reliability of such studies. Some studies do not take into account “underlying directional skeletal asymmetry, age, sex or sample size” (Stirland 1993:106). Another factor to consider is the individuality of each skeleton, and their respective individual past life. Proof of activity or occupation is very often based on “bony changes that may have a variety of explanations” (ibid). So how is it possible to determine activity related change in the human skeleton?

One factor that must be taken into account is the origins of asymmetries in the skeleton. Schultz demonstrated that it was only the maximum length of the Humerus that was

present congenitally and also demonstrated more variation in humans than in any other primate (Schultz 1937 in Stirland 1993). Further work with human foetal material showed that the total muscle and bone weight was greater on the right side on ninety percent of the foetuses studied (Pande & Singh 1971 in Stirland 1993). It can be accepted then, that asymmetry in humeral length is congenital. However other studies have found all the skeletal material studied to be longer and heavier on the right side (Latimer & Lowrance 1965 in Stirland 1993). Therefore it is clear that not all asymmetries are congenital, and shows that there must be other explanations.

Stirland's (1993) study takes all the above factors into account. The Humerii were taken from two medieval British sites: the Mary Rose and a medieval cemetery in Norwich. The Humerii were measured thoroughly, and assigned into two broad age groups. All were from male skeletons. The horizontal dimension of the Greater tubercle was also taken. The Norwich males were found to be more asymmetric than the Mary Rose males, suggesting that the Mary Rose males used both arms equally over time, whereas the Norwich males only frequently used one arm (Stirland 1993). The Mary Rose males however, were significantly larger than the Norwich men in the left shoulder (Stirland 1993). Stirland links this to the professional use of the heavy medieval longbow.

Another study into past lifestyle interpretation from musculoskeletal markers looked at the Natufian period. The study found that musculoskeletal stress markers reflected "higher functional demands and pronounced right side asymmetry among Natufian males" (Peterson 1998:378). Males also scored consistently higher with regard to muscle groups that are associated with overhand throwing motions (Peterson 1998).

Most skeletal samples show that generally, males have greater muscle markings than females (Cohen, 1989 cited in Weiss, 2003); this fact is often attributed to the differences in activity patterns between males and females, especially in historical times. Cook & Dougherty (Cook & Dougherty 2001 cited in Weiss 2003), for example, found that adult males from Chirikof Island in Alaska had "greater upper limb muscle markers than females" (Cook & Dougherty 2001, cited in Weiss, 2003:230), due to their activities

which involved extensive rowing and hunting. Asymmetries (differences) between paired bones can also be attributed to trauma, or, if no signs of trauma are present, to handedness (Churchill & Formicola 1997).

Bridges (1989) suggested that changes in physical activities of peoples in the South-eastern United States were related to a change in agriculture and sexual division of labour (Bridges 1989). Theoretically, agricultural groups “spend more time on subsistence activities, many of which (e.g. hoeing, pounding seed crops) are physically arduous” (Bridges 1989:385). This would mean that the bones should reflect this with musculoskeletal stress markers. The findings of Bridge’s study show that the agriculturalists from Mississippi had “thicker and stronger long bone diaphyses” (Bridges 1989:391) than the archaic hunter-gatherers from the same area that they were compared to. Bridges also states in the study, that findings varied in different areas of the United States, possibly due to differing subsistence methods in different areas (Bridges 1989).

A paper by Robb (1998) shows that other activities that have been successfully reconstructed including horseback riding, rowing and carrying. However, the paper also highlights problems in the methodology of musculoskeletal stress marker studies. Muscle insertion sites are morphologically complex and often difficult to observe, and it must be taken into account that the skeleton undergoes many different stresses throughout the course of life (Robb 1998). The paper also considers our limited knowledge and imagination “as to the range of possible tasks and the ways ancient people performed them” (Robb 1998:366). This last point, however, can be disagreed with to some extent; depending on the time period being studied, a lot can be known about the way people in the past performed tasks, and with the growth of experimental archaeology, imagination is no longer limited.

When all the above examples are considered, in the case of the Newport skeleton, how can we produce a reliable assessment of the skeletal indicators that determine robusticity and handedness? What can the data acquired from the skeleton be compared to in order to

determine how robust the individual was (for example, was the individual more or less robust than other individuals?)

The first question can be answered in the statistical methodology of social science research. Averages are used in quantitative research to “increase correlations and enhance predictability” (Weiss 2003:231). Averaging uses statistical principles to achieve this. Assuming that each measurement, known as X , is composed of two unobservable values: the ‘true’ value, known as t , and the error value, known as e (Spearman 1904 in Weiss 2003). The more X values that are gathered and used to produce an average (mean) cause the e value to have less effect and therefore, a more reliable average is gained.

Therefore, in this dissertation it is intended that the results from the assessment of the Newport skeleton will be compared to averaged (mean) results for the same muscles obtained from the Cwm Nash skeletal material (late historic period) housed at the University of Wales, Lampeter.

The next issue to resolve is exactly what skeletal indicators and muscle markers are going to be examined? After all, the human skeleton is large, with hundreds of muscles.

Before the study continues it is important to clearly define the terminology to be used when discussing skeletal evidence for physical activity in the past. There are various terms for this evidence, not all of which are suitable; therefore it is important to be consistent in the use of one term. Common terms for skeletal indicators of physical activity include ‘enthesopathies’, ‘markers of occupational stress’, ‘activity induced stress markers’ and ‘musculoskeletal stress markers’ (Steen & Lane 1998). The above terms have been employed when assessing a wide variety of osteological conditions including trauma, enthesopathic lesions and degenerative joint disease, but not all of them are appropriate for this study.

An enthesopathy refers to a “disorder of the muscular or tendinous attachment to bone’ that is ‘a morbid condition or disease’ (-pathy) at ‘the site of attachment of a muscle or

ligament to bone' (enthesis)" (Anderson 1994 in Steen & Lane 1998). Therefore, an enthesopathic condition may not only occur in physical activity but also in a diseased condition as well. The term 'enthesopathy' therefore, is not suitable for describing the remodelling of muscle and ligament attachment sites in bone that occur as a result of physical activity alone.

'Markers of occupational stress' and 'activity induced stress markers' are also inappropriate to use in a study such as this one as they are too vague and can be applied to joint disease, trauma and cultural factors of skeletal remodelling (Steen & Lane 1998). In this study, the most appropriate term to use is 'musculoskeletal marker' or 'MSM' which is defined as "a distinct skeletal mark that occurs where a muscle, tendon or ligament inserts...into the underlying bony cortex" (Hawkey & Merbs 1995 in Wilczak 1998). This term only applies to changes produced during habitual use of muscles and ligaments at their attachment sites, and therefore is most appropriate to this study.

It is believed that physical activity and exercise encourage development of bone mass, as well as reducing the risk of "osteoporotic fractures...and providing better strength, flexibility, balance and reaction time" (Kannus, Haapaslo et al 1994:279). This means that an individual who does a high amount of physical exercise would theoretically have more skeletal evidence of their level of activity than an individual who did very little. This 'skeletal evidence' appears in the form of musculoskeletal markers.

Long bones are most useful in determining height and stature, so measurements of these will be taken from each bone used. The measurements from the Newport skeleton will then be compared to aggregate results from comparison material (see Appendix I for details of bone measurements).

Long bones are also the most useful when considering skeletal indicators, as major muscles for most day-to-day activities that exert more stress on the skeleton and its muscles (for example, archery or rowing) are present. Much study has also been carried out on arm bones in the past and so there are many studies that can be used in research.

Therefore, of the arm bones (Humerus, Radius & Ulna), 7 muscle markers will be observed: 4 from the Humerus; 2 from the Radius and 1 from the Ulna. These markers were used in a study by Hawkey & Merbs (1995) and also by Weiss (2003) and further justification is given below.

On the Humerus, the *Deltoid*, *Lattissimus dorsi*, *Pectoralis major* and *Teres major* muscle markers (see Plate 1) will be observed. On the Radius, the *Biceps brachii* and *Supinator* muscle markers (see Plate 2) will be observed and on the Ulna, the *Triceps brachii* muscle marker (see Plate 2).

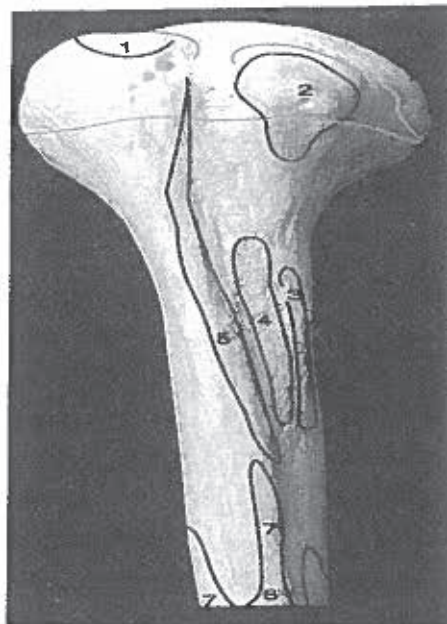


Plate 1: Musculo-skeletal markers on the upper humerus. Number 3 is the Teres major, Number 4 is the Lattissimus dorsi, Number 5 is the Pectoralis major and Number 7 (at the bottom) is the Deltoid. (Taken from McMinn et al 1993:104)

These sites are easy to identify and have also been explored in previous literature

The leg bones of the Newport Skeleton will not be used in this study. There is a lack of literature on the musculoskeletal study of leg bones, and material that is present is exceedingly hard to access. Also, the data generated would be immense, and hard to fit into one dissertation. The lower long bones will, however, be measured to produce an

estimate of height and stature, something which the upper long bones are not as reliable for.

Each muscle marker will be observed using methods developed by Hawkey & Merbs (1995) as observer error rates are low due to Hawkey and Merbs providing identifiable characteristics accompanied by photographs and guidelines for each muscle marker. Another reason for choosing muscle insertion sites is that muscles produce the maximum pull at their insertion sites leading to more observable characteristics (Hawkey & Merbs 1995). The method is detailed below. The musculoskeletal markers will also be measured as set out in Bass (1995) as this provides a detailed description of how and where to measure each bone (See Appendix I for full measurements to be taken).

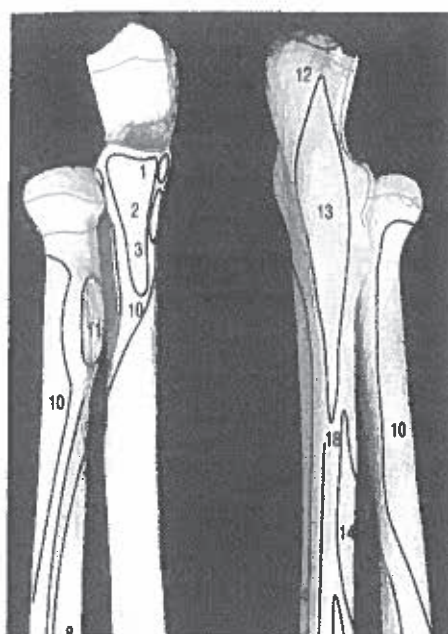


Plate 2: The musculo-skeletal markers of the upper radius and ulna. On the radius (left in picture), number 11 is the Biceps, number 10 is the Supinator. On the Ulna (on right), number 12 (at the top) is the Triceps brachii. (Taken from McMinn et al 1993:110)

Each of the muscle marker sites will be observed on 2 criteria: Robusticity and Stress Lesions. There are four grades (0-3) of increasingly observable characteristics that are used in the observation, 0 being the absence of characteristics, 3 being the most observable.

The first category, robusticity (see Plate 3), is used to describe the normal appearance of the areas where muscles attach. Grade 1 (R1) means that there are no distinct crests or ridges, although elevation can be felt when the area is touched. Grade 2 (R2) signifies uneven bone with a “mound-shaped elevation” (Weiss 2003:233). In Grade 3 (R3) there are distinct and sharp crests or ridges (see Plate 3).



Plate 3. Robusticity category at the *biceps brachii* insertion site. From left to right the categories are R1 = faint, R2 = moderate & R3 = strong. (From Hawkey & Merbs 1995:327)

The second category, stress lesions (see Plate 4) is defined as “pitting into the cortex” (Weiss 2003:233). Grade 1 (S1) has shallow pitting less than 1mm in depth. Grade 2 (S2) has pitting between 1-3mm in depth and less than 5mm in length. Grade 3 (S3) has pitting greater than 3mm in depth and more than 5mm in length (see Plate 4).

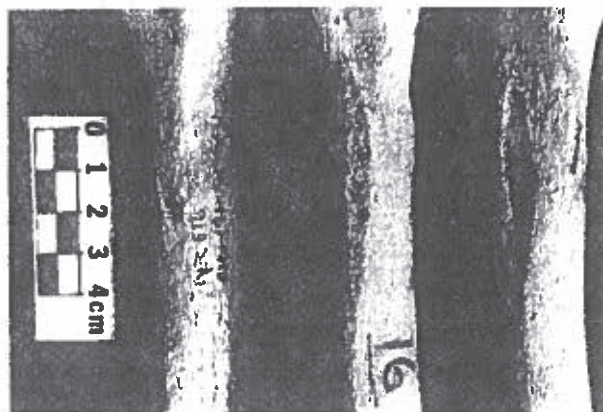


Plate 4. Stress lesion category at the *pectoralis major* insertion site. From left to right, S1=faint, S2=moderate & S3=strong. (from Hawkey & Merbs 1995:328)

The results for the above methodology are presented in the following chapters.

Chapter 3: The musculoskeletal assessment of the Newport skeleton.

This chapter presents the results obtained from the musculoskeletal assessment of the Newport skeleton (see Chapter 2 for the methodology) and compares these results with the results obtained (following the same methodology) from the Cwm Nash skeletal material, which will be used as a comparison when discussing the results in the next chapter.

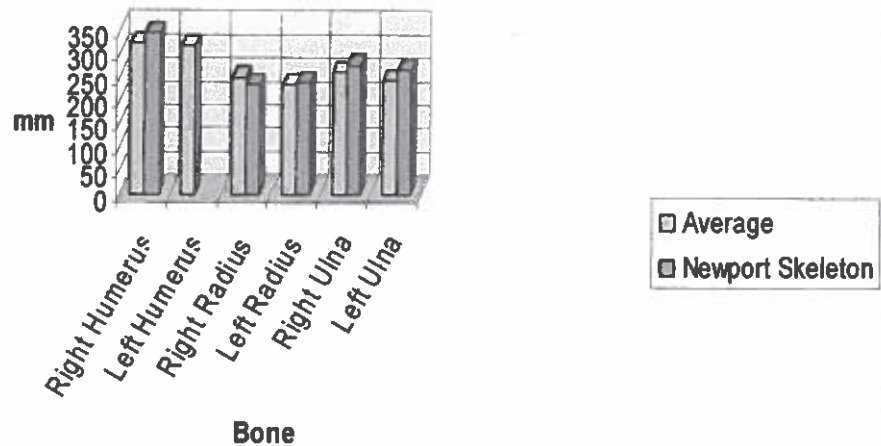
All measurements in this chapter are in millimetres (mm) unless otherwise stated. Where appropriate, any calculations, formulas or diagrams of bone measurements are listed in the appendices. Where there is a dash (-), the bone was not present. Where there is an asterix (*) the measurement is approximate due to bone damage, but measured as accurately as possible. It is important to remember that the bone measurements, if the bones were not damaged, would be larger than they are. The 'average' and 'Newport' measurements are in bold to allow easy comparison. 'Average' refers to the calculation of the mean figure using the relevant data from the three Cwm Nash skeletons.

Maximum length measurements.

Table 1: The maximum lengths of upper arm bones of the skeletal material used in this study.

	Right Humerus	Left Humerus	Right Radius	Left Radius	Right Ulna	Left Ulna
214/009	321.5	-	-	-	260	-
214/012	322	319	249	242	261	261
214/013	-	-	-	223.5	-	243
Average	321.75	319	249	232.75	260.5	243
Newport	-	322*	234.5*	238.1*	276*	264*

Chart 1: Comparison of Bone Lengths between the Newport Skeleton & the Comparison material



These results show that the Newport skeleton's humerus (322mm*) and ulnae (276mm* & 264mm*) are longer than that of the comparative material. Both radii are damaged, but even with the damage, the left radius exceeds the comparative material in length and the right is only slightly shorter. Without this damage the bones would have certainly been greater in length than the comparative material and the average (321.75mm for the humerus and 260.50mm and 243.00mm for the left and right ulnae respectively).

Robusticity Indexes (humerus only)

Table 2: Robusticity Indexes for the humerus

	Right humerus	Left humerus
214/009	20.84	-
214/012	21.73	21
214/013	-	-
Average	21.29	21
Newport	-	22.04*

Caliber Indexes (Ulna only)

Table 3: Caliber Indexes for the ulna

	Right ulna	Left ulna
214/009	16.95	-
214/012	-	18.3
214/013	17.29	16.23
Average	17.12	17.26
Newport	18.47*	17.04*

Comparisons of the musculoskeletal markers (MSM's).

Table 4: Comparison of lengths and widths of musculoskeletal markers for comparative material and the Newport skeleton

	Length				Width			
	Comparison Average		Newport Skeleton		Comparison Average		Newport Skeleton	
Muscle	Right	Left	Right	Left	Right	Left	Right	Left
<i>Deltoid</i>			-	-			-	-
<i>Lattissimus dorsi</i>	38.31	37.38	-	39.24	2.31	2.29	-	3.52
<i>Pectoralis major</i>	94.31	91.67	-	93.26	8.34	7.35	-	8.98
<i>Teres major</i>	35.07	35.10	-	59.03	3.91	2.32	-	10.03
<i>Biceps</i>	22.55	20.19	20.44	18.67	9.67	10.29	16.67	16.05
<i>Supinator</i>	72.03	62.88	85.35	87.62	15.54	14.42	13.92	10.78
<i>Triceps brachii</i>	12.36	14.08	-	-	14.80	15.99	-	-

Table 5: Comparison of Robusticity and Stress Lesion grades for the comparison material and the Newport skeleton.

	214/009		214/012		214/013		Newport	
Muscle	R	L	R	L	R	L	R	L
<i>Deltoid</i>	R1/S1	-	R1/S1	R1/S1	-	-	-	R1/S1
<i>Lattissimus dorsi</i>	R1/S1	-	R1/S1	R1/S1	-	-	-	R1/S2
<i>Pectoralis major</i>	R1/S1	-	R2/S1	R2/S1	-	-	-	R2/S2
<i>Teres major</i>	R1/S1	-	R1/S1	R1/S1	-	-	-	R2/S1
<i>Biceps</i>	R1/S1	-	R2/S2	R2/S1	R2/S1	-	R3/S1	R2/S1
<i>Supinator</i>	R1/S1	-	R1/S1	R1/S1	R1/S1	-	R2/S1	R1/S1
<i>Triceps brachii</i>	R1/S1	-	R1/S1	R1/S1	R1/S1	-		

R1, 2 or 3= Robusticity Grade 1, 2 or 3, as described in Chapter 2.

S1, 2 or 3 = Stress Lesion Grade 1, 2 or 3 as described in Chapter 2.

The comparisons of robusticity and stress lesion grades show that the Newport skeleton's musculoskeletal markers consistently have grades equal to and in excess of the comparative material. With regards to the length and width measurements of the musculoskeletal markers, the markers generally fall into two groups-they are either longer and wider than the comparative material or shorter and squatter.

This information is both highly interesting and significant and this significance will be discussed in the following chapters.

Chapter 4: Analysing the results of the musculoskeletal assessment of the Newport skeleton.

The results of the musculoskeletal assessment of the Newport skeleton presented in the last chapter are both highly significant and interesting. The results presented in the previous chapter allow us to infer an individual identity that is now represented by the Newport skeleton. This chapter aims to expand on why this is the case and present what the musculoskeletal assessment of the Newport skeleton can tell us about the robusticity, handedness and lifestyle of the individual.

Musculoskeletal assessment can be vital in inferring identity to a skeleton as the type of musculoskeletal markers observed and the way in which those musculoskeletal markers are expressed are believed to be caused by the amount, duration and type of stresses placed on those markers (Hawkey & Merbs 1995). It is vital to remember that during an individual's life, bone is a living tissue, which is constantly being formed and broken down. This leads to bone having the ability to repair itself and also to "adapt its form according to the strains put on it" (Mays 1998: 3) leading to the development of the aforementioned musculoskeletal markers (Hawkey & Merbs 1995; Larsen 1997). This is a long standing and well researched premise originating in the 19th Century with Wolff's Law, stating that "the form of the bone being given, the bone elements place or displace themselves in the direction of the functional pressure and increase or decrease their mass to reflect the amount of functional pressure" (Wolff 1892 cited in Mays 1998: 3).

There is a great deal of information to be interpreted in this study, so this chapter is presented in five sections: one interpreting information about the sex, stature and robusticity of the Newport skeleton, one section each for the humerus, the radii and the ulnae, and a final section drawing all the information together.

An * represents an approximate measurement due to bone damage. Measurements in this chapter appear in both metric and imperial forms.

Sex, Stature and Robusticity

An important place to start when aiming to interpret the robusticity and lifestyle of an individual is to discover their biological sex, as this will undoubtedly affect the interpretation of factors such as stature, robusticity and musculo-skeletal markers, based on the assumption that sexual dimorphism and sexual division of labour was present in past populations.

There are well defined set criteria for sexing a human skeleton with certain well researched and distinguishable landmarks used for this purpose (Bass 1995). The pelvis is “the best area to determine the sex of a skeleton...the highest accuracy has been achieved using this bone” (over 95% accuracy) (Bass 1995: 208). The pelvis has many areas that are used for sex estimation including the subpubic angle, the ventral arc, the sciatic notch and the sacroiliac joint (Bass 1995). The skull, which is the “second best area of the skeleton to use for determining sex” (Bass 1995: 85) also has a high accuracy rate (ibid).

However, in this case, the individual has no skull, and a damaged pelvis, so sex was assessed on the basis of the most perfectly preserved pelvic characteristic (the sciatic notch). Due to the absence of the other diagnostic indicators of biological sex, the Femur may be used, which according to Bass (1995: 229) has contributed a large amount to sex estimation and has an 85-90% accuracy rate.

The pelvic characteristic that was used in this study was the assessment of the sciatic notch based on its shape and size. The rule when assessing the sciatic notch is that if, when the thumb is placed in the sciatic notch, considerable side-to-side movement is possible, the individual is female. If little side-to-side movement is possible then the individual is a male (Bass 1995). When assessing the Newport skeleton’s sciatic notch, side-to-side movement is very limited, which shows the individual to be male.

Table 6: Femoral maximum lengths and sex determination (taken from Bass 1995: 231 after Stewart 1979)

Female	Female?	Sex indeterminate	Male?	Male
<42.5 cm	42.5-43.5 cm	43.5-46.5 cm	46.5-47.5 cm	>47.5 cm

When assessing femoral length, there are several maximum length ranges presented (see Table 6, above) The Newport Skeleton's maximum femoral measurement is 460 mm (46 cm) (this is approximate as the bone is damaged at both proximal and distal ends)-the bone would originally have been longer). According to criteria laid out by Stewart (1979 in Bass 1995:231, see Table 6), 46 cm is at the top of the 'sex indeterminate range'. However, as the femur, when complete, would have been longer, we can safely say that the individual would fall into the male? / male category, supporting the Newport skeleton's assignation as a male.

Stature is another important, if more complex characteristic to interpret when establishing individual identity. Stature calculations are most often carried out by femoral measurements as they are the most reliable (Bass 1995). The upper long bones, although equally well researched, "should not be used in the estimation of stature unless no lower limb bone is available" (Trotter & Glesner 1958 in Bass 1995:169) as they have a much higher standard error than the lower limb bones (Bass 1995).

Assessing the stature of the Newport skeleton is even more problematic due to bone damage but was felt to be possible. For the purposes of this study, stature was assessed using femoral measurement and measurement of the ulna, (despite the reservations previously mentioned). The femur, as previously mentioned, is badly damaged at both proximal and distal ends, the stature estimate resulting from calculation using the femur will be and under-estimate and therefore shorter than the individual's actual stature. Of all the long bones present in the Newport skeleton the ulnae are the least damaged, and providing the fact that the upper limb bones produce a less reliable estimate is kept in

mind, the ulnae can be used to estimate the maximum possible height of the individual. It is important to note that the true stature of the individual will be somewhere in between the two estimations obtained by the measurement of these two bones.

Using the maximum measurement of the damaged femur (460 mm), the corresponding stature is 172.25 ± 3.94 cm. At the top end of this range (176.19 cm), the stature is approximately 5 ft and 8 inches. Using the maximum length of the more complete right ulna (276 mm) the corresponding stature is 179.33 ± 4.72 cm. At the top end of this range (184.05 cm), the stature of the Newport skeleton could be as much as 6 ft (see Appendix II for stature formulae and calculations).

Taking into account the bone damage and reliability of the stature estimates, it is certain that the Newport skeleton was at least 5 ft 8 inches but less than 6 ft tall. These calculations are highly significant when compared to the average height of a UK white male today at 5 ft 7 inches (173 cm) (Sproston & Primatesta 2003) and the average height of the comparative material at 5 ft 5 inches. This means that the Newport individual was tall, even by modern day standards.

Robusticity can be assessed by bone measurements-in this case, Robusticity indexes of (humerus only) and caliber indexes (ulnae only) have been used. Varying degrees of robusticity, caused by bone adaptation (Knüsel 2000) can help to understand past lifestyle and activity patterns (ibid) based on the assumption that past physical activity will affect bone formation and adaptation (ibid). All of the formulae and calculations used to work out these indexes can be found in Appendix II.

The robusticity index (which “expresses the relative size of the shaft” (Bass 1992:152)) for the Newport skeleton’s left (and only humerus) is 22.04. For the comparative material, the average robusticity index of the left humerus is 21. The caliber index (“expresses the relative delicacy or robustness of the bone as a whole-the greater the index, the stouter the bone” (Bass 1992:173)). For the Newport skeleton’s ulnae the

caliber indexes were 18.47 and 17.04 (right and left respectively). The average caliber index for the comparative ulnae is 17.12 and 17.2 (right and left respectively).

These calculations show that with the exception of the left ulna, the Newport skeleton is more robust than the comparative material (the exception of the left ulna can be explained by bone damage effecting the calculations). Another significant point to note is that the right ulna is much more robust than the left, a point which has important implications when interpreting the handedness of the individual. This line of reasoning will be discussed later in this chapter.

When studying the musculoskeletal attachments of an individual, it is believed that musculoskeletal markers can aid researchers in understanding daily activity patterns of the individual being assessed. This premise is based on the assumption that the “degree and type of marker are related directly to the amount and duration of habitual stress placed on a specific muscle (Hawkey & Merbs 1995: 324).

The muscle markers used in this study have been researched before (Hawkey and Merbs 1995; Stirland 1993 & 1998; Bridges 1989) and are well defined and recognisable. The method of assessment used here is that of Hawkey & Merbs (1995), which eliminates complete and total reliance on observer experience (ibid).

The humerus.

The left (and only!) humerus of the Newport skeleton (see Plate 3) at 322* mm is longer than the average length of the comparative left humerus at 319mm. This is despite substantial damage from the neck of the humerus upwards, and slight damage to the lateral epicondyle and capitulum (see Plate 5).



Plate 5. The left humerus of the Newport skeleton (right) & Cwm Nash 214/012. Note on the Newport skeleton damage at the proximal and distal ends.

The muscle attachments identified on the humerus are the *deltoid*, *lattissimus dorsi*, *pectoralis major* and *teres major* (See chapter 2 for details of methodology, see Plate 1 for their locations and Table 7, below, for details of muscles and their functions). The *deltoid* (which cannot easily be measured in terms of length and width) has a robusticity grade of 1 and a stress lesion grade of 1 (The higher the robusticity grade, the more robust the musculoskeletal marker is. The higher the stress lesion grade is, the greater the amount of stress that the bone was under, and the increased likelihood that the individual damaged that muscle in life. See Chapter 2 for full explanations of these grades). This is equal to the comparative material which also shows consistent R1/S1 grades. This means that although the deltoid is noticeable, it is not particularly pronounced. The deltoid is a muscle commonly used in shoulder movements (from shrugging to throwing), arm swinging and is used to aid the arm in resisting downward drag (e.g. holding a heavy object) (Warwick & Williams 1973).

The *lattissimus dorsi* of the Newport skeleton with a length of 39.24 mm and a width of 3.52 mm is both longer and wider than the average measurements of the comparative material (length = 37.38, width = 2.29). The robusticity and stress lesion grades for the *lattissimus dorsi* are R1 and S2. The robusticity grade is equal to the comparative material but the stress lesion grade is greater. The *lattissimus dorsi* is a key muscle in

both adduction and extension, violent expiration (breathing out) and deep inhalation (breathing in) and also in activities such as climbing and depressing the raised arm against resistance (Warwick & Williams 1973) (see Table 7 for a full list of all muscle functions).

Table 7: Muscles and their functions (compiled using information from Warwick & Williams 1973).

Muscle	Function
<i>Deltoid</i>	Shoulder movements, arm swinging, resisting downward drag.
<i>Lattissimus dorsi</i>	Adduction, extension, violent expiration, deep inhalation, climbing, depressing arm against resistance.
<i>Pectoralis major</i>	See <i>Lattissimus dorsi</i> functions
<i>Teres major</i>	Violent active movements, maintaining static postures.
<i>Biceps brachii</i>	Lifting, flexion of the elbow, rapid movements.
<i>Supinator</i>	Rotates radius, acts with the <i>biceps brachii</i> in lifting, especially lifting the load towards the face.
<i>Triceps brachii</i>	Extension, pushing/thrusting forward and pushing upwards (i.e. a press-up type movement). Also draws humerus backwards.

The fact that the *lattissimus dorsi* is longer and wider on the Newport skeleton and has a greater stress lesion grade is highly significant. This is because muscle and musculoskeletal attachments develop due to high load (e.g. weight) and high repetition of movements and activities (Bemben et al 2000). This means that the Newport individual was undertaking higher levels of exercise involving deep and heavy breathing and also

higher levels of work involving physical loading than the comparative material. Another interesting and significant point is that stress lesions usually appear in a moderate to pronounced form after muscle tearing, pulling or rupturing. The *lattissimus dorsi* is the only musculoskeletal marker on the humerus to have a moderate stress lesion grade which could indicate a pulled or torn muscle at some point in the Newport individual's life.

The *pectoralis major* of the Newport skeleton with a length of 93.26 mm and a width of 8.98 mm is also longer and wider than the average comparative length and width (length = 91.67 mm & width = 7.35 mm). The robusticity and stress lesion grades (R2 and S1 for the Newport skeleton) are equal to that of the comparative material. The *pectoralis major* is used in the same activities as the *lattissimus dorsi* (see Table 6). The high robusticity grade and the longer than average length and width of the *pectoralis major* supports the suggestion that the Newport individual was, at some point in his life undertaking high levels of exercise and physical labour.

The final musculoskeletal marker on the humerus to be analysed is the *teres major*. On the Newport skeleton the marker was significantly longer at 59.03 mm and wider at 10.03 mm than the comparative average length of 35.10 mm and width of 2.32 mm. The *teres major* was more robust (R2 grade) than the comparative material (all R1 grades) and the stress lesion grades were equal. The function of the *teres major* in violent active movements e.g. striking, throwing, movement of arms during sprinting etc and also in maintaining static postures (e.g. holding an object in a certain position), the extremely large dimensions of this musculoskeletal marker and the high robusticity grades are highly significant and support previous suggestions in this chapter that the Newport individual, at some point in his life undertook large amounts of heavy, physical and possible violent exercise.

Biomechanical studies also support the suggestions made here that the musculoskeletal markers are increased due to high levels of certain activities. Seireg & Arvikar (1989) for example, document a "significant increase in the muscles of the upper extremities"

(Seireg & Arvikar 1989:318) when the subject is standing straight holding a 22.75kg weight in each hand.

The ulnae (see Plate 6).

Both the right and left ulnae of the Newport skeleton with measurements of 276* mm and 264* mm (right and left respectively) were longer than the comparative average (260.5 mm and 243 mm). Equally, both had greater caliber indexes (18.47 * & 17.04 *; right & left respectively), meaning that the Newport individual is more robust than the comparative material, whose average caliber indexes were 17.12 for the right ulna and 17.26 for the left.

In terms of musculoskeletal assessment, both ulnae were badly damaged and both the proximal and distal ends (see plate 6), so measuring and assessing the *triceps brachii* musculoskeletal marker (see Plate 2) was impossible. However, both radii are very robust and other musculoskeletal markers, such as the *flexor digitorum profundus* (aids in flexing the wrist and fingers), the *pronator teres* and the *brachioradialis* (active in rapid or forced movement of the forearm.). These muscle markers are highlighted by Warwick & Williams (1973) as being highly significant and are used here in place of the *triceps brachii* musculoskeletal marker. Both the *pronator teres* and the *brachioradialis* are highly pronounced with robusticity grades of 2 or 3 (the right being the most pronounced), which supports suggestions made in this chapter that the Newport skeleton was a highly active, robust and physical individual.

When considering handedness, again, it is significant that the right ulna is longer than the left and that the right bone has a greater caliber index, all suggesting that the right arm was the dominant arm. This is another significant finding, as the majority of populations today demonstrate right hand dominance, and is a characteristic which helps to define an individual (Steele 2000; Mays et al 1999)



Plate 6. The ulnae. From left to right-Cwm Nash 214/012 right ulna, Newport skeleton right ulna, Cwm Nash 214/012 left ulna, Newport skeleton left ulna. Note damage to both proximal & distal ends, with particular attention to the damage of the *triceps brachii* insertion site (see Plate 2).

The radii

The two musculoskeletal markers on the radii, the *biceps brachii* and the *supinator* (see Plate 2 and Chart 6) are both involved in physical activities such as lifting, flexing of the elbow and rapid movements (Warwick & Williams 1973). The right biceps of the Newport skeleton are highly robust (R3 grade) and are shorter and wider than those of the comparative material (R1-R2 grades). This suggests a larger muscle mass concentrated in a smaller area than the comparative population, giving the muscle in this particular area greater power. The high robusticity grade suggests high levels of physical activities such as lifting as does the moderate stress lesion grade (S2). As mentioned for the *lattissimus dorsi* musculoskeletal marker, moderate to pronounced stress lesions occur in muscles that have been pulled, torn or ruptured, suggesting that the *biceps brachii* was at some point in the Newport individual's life, damaged.

The left *biceps brachii* of the Newport skeleton is shorter and very slightly narrower than the right *biceps brachii* and the *biceps brachii* of the comparative material. The robusticity and stress lesion grades of the Newport skeleton remain higher than or equal to the comparative material (see Tables 4 & 5). This data still supports the suggestions of

high levels of physical activity but also suggests something else that is highly significant and related to handedness.



Plate 7. The radii. From left to right: Cwm Nash 214/012 right radius, Newport skeleton's right radius; Cwm Nash 214/012 left radius, Newport skeleton's left radius. Note on the Newport skeleton, damage to proximal & distal ends & also the large *biceps brachii* insertion site.

When comparing the right and left radii of the Newport skeleton (see Plate 7), there are implications for handedness. The right *biceps brachii* is shorter and wider than the left, suggesting that the right arm was used more and therefore developed greater mass than the left. This cannot be supported by bone measurements as the bones are badly damaged, but the left bone has the least damage, whereas the right (and slightly shorter bone) has the most damage. It is entirely possible that the right bone could have originally been longer, but it is now impossible to tell.

The right *supinator* of the Newport skeleton has a higher robusticity grade than the left which also suggests that the Newport individual favoured his right arm over his left as does the data that shows that the right *supinator* is shorter and wider than the left.

When this wealth of information is interpreted it is clear to see that the Newport individual was a tall extremely robust male (between over 5ft 6" and 6ft). Handedness in humans is the "tendency to prefer consistently to use one hand in skilled tasks" (Steele

2000: 307). Handedness is a characteristic of great interest as it is seen to be “individuating” (ibid). This “individuating” (ibid) characteristic is of great interest in this case as it may tell us more about the lifestyle and activity patterns of the individual. Handedness is more difficult to assess due to missing or damaged bones, but overall interpretation of the bone measurements and musculoskeletal attachments suggest that the Newport individual favoured his right arm.

Biomechanical studies of the musculoskeletal system also support this. Studies show that with unilateral weight lifting (weight on one arm only), muscles of the load-bearing arm are “significantly more active” (Seireg & Arvikar 1989: 319) than the arm bearing no load. The forces running through muscles such as the *deltoid*, *teres major* and *biceps brachii* muscles are much higher in the load bearing arm which would lead to increased development of these musculoskeletal markers. The musculoskeletal attachments clearly and consistently show levels of robusticity and stress lesions equal to or more often greater than the comparative average indicating that the Newport skeleton used those muscles more frequently and under higher loads. The functions of the muscles show that the high levels of physical activity undertaken by the Newport individual could have included violent or sudden movements (such as throwing or striking), lifting, resistance and high levels of cardiovascular exercise leading to deep inhalation and violent expiration.

Another activity which was possibly carried out by the Newport individual in his life is shooting a bow, especially when considering the high probability that the Newport skeleton was right handed. When a bow is drawn, the *biceps brachii* and the *lattissimus dorsi* muscles flex the right elbow and draw the right shoulder back. The left arm is extended by the *triceps brachii* (Hawkey & Merbs 1995). Considering the extremely pronounced right *biceps brachii* musculoskeletal marker and the faint left *lattissimus dorsi* marker, this is also another possible activity that the Newport individual may have undertaken habitually or for an intensive amount of time.

Another occurrence that can be noted in the Newport skeleton is the possibility that at some point during the individual's lifetime he pulled ruptured or tore several of his upper arm muscles, another factor which supports the theory that the Newport individual undertook heavy, physical or violent labour.

Chapter 5: Discussion & Evaluation: What can be said about the lifestyle and activity patterns of the individual?

The musculoskeletal assessment shows that it is likely that the Newport individual favoured his right arm and musculoskeletal markers support the findings of above average robusticity. Interpreting the data obtained in the musculoskeletal assessment, it is suggested that the Newport individual had a very physical, active lifestyle; with an occupation that involved heavy and repetitive manual labour that possibly caused muscle injuries and which caused certain musculoskeletal markers to develop significantly.

It is not possible to state with certainty a certain occupation for the Newport individual (e.g. a soldier, a labourer); it is only possible to suggest the *types* of activities which would have caused the observed effects.

During the final stages of writing this dissertation Radiocarbon dates (courtesy of Beta Analytic) were returned for the Newport skeleton, which is highly interesting, especially for the purposes of this dissertation. The Newport skeleton is dated to 2130 ± 40 yrs BP. This calibrates to between 200-100 BC to 1 sigma, placing the Newport skeleton in the mid-to-late Iron Age.

This is highly significant when interpreting the results of the musculoskeletal assessment. The assessment showed high levels of robusticity with musculoskeletal moderate to high robusticity grades and moderate stress lesion grades. The functions of the musculoskeletal markers are physical, active and violent, possible activities involving lifting and carrying heavy loads, cardiovascular activities (for example, sprinting), striking (for example, digging or blacksmithing) climbing and possible use of a bow.

These suggested activities are consistent with the popular image of Iron Age Peoples reconstructed by experimental archaeologists and supported by excavations all over the world. Manual labour, farming activities (for example ploughing and hoeing),

blacksmithing, mining, woodland clearance, digging, building and thatching (Pryor 2004; Reynolds 1987a; 1987b) are all examples of day-to-day activities in the Iron Age.

As well as experimental archaeology helping to reconstruct Iron Age activities, other evidence of the heavy manual labour prevalent in the Iron Age can be found by looking at archaeological evidence excavated from Iron Age hillforts.

Forts and defended settlements such as Castell Henllys and Llawhaden (both in West Wales) were prevalent in the Iron Age and many have massive defences such as deep ditches (some over 10 feet deep), Chevaux de Frises and barbican annexes (Davis 1992; Mytum 1987; Williams 1985)-intensive manual labour would have been required to build and maintain these defences. Experimental archaeology has demonstrated this (Reynolds 1987b), and now it is possible to support these findings with musculoskeletal evidence.

There are such forts close to Newport where the skeleton was found-at Llanmelin, near Caerwent and at Twyn-y-Gaer near Abergavenny (about half an hour from Newport) (Brewer 1993). Llanmelin also had extensive defences. As well as building the defences of the nearby hillforts, it is also feasible then that the Newport individual may have been an inhabitant of a nearby fort and helped defend them from invasion or perhaps he was an invader-we shall never know, but one thing is certain-that the information gained from the musculoskeletal assessment of the Newport skeleton infers activity patterns that are consistent with both archaeological and popular images of life in the Iron Age.

Evaluation

Whilst this study has achieved all of its aims, it is not possible to say that there were no problems and no ways to improve the study. This evaluation will identify and discuss any problems, suggest how a further study of this type could be improved and suggest how this work could be progressed further and discuss its uses in archaeology and anthropology.

Most of the problems that a study of this type will come across are issues of reliability and interpretation. Hawkey & Merbs (1995) recommend caution is observed when using small sample sizes, as was the case in this dissertation. Hawkey & Merbs (1995) also stress that it is only possible to identify daily activity patterns and not specific activities, which is especially true in this study where little is known about the background of the Newport skeleton. Further problems could be caused when making comparisons between material due to both the “morphology and the variability” (Stirland 1998:354) of the areas being examined.

Problems such as complex morphology and observational difficulties (Robb 1998) were overcome in this study by the use of a previously tried and tested method, with observer errors being all but eliminated (see Chapter 2) (Hawkey & Merbs 1995). The musculoskeletal sites themselves may cause reliability to decrease as the numbers of different biomechanical stresses on the skeleton over a lifetime are immense, and many activities carried out throughout the life of the individual may be recorded (Robb 1998). This problem is not possible to avoid completely, but by taking into account these factors, and suggesting possible patterns of activity as opposed to specific activities, the severity of the problem can be lessened.

This study could be improved by increasing the sample size of the comparative material and also increasing the number of musculoskeletal markers to be observed—for example, the inclusion of the Femur and analysis of more musculoskeletal markers on the arm bones. This would not only increase reliability but also provide more information about the Newport individual’s activity patterns and lifestyle.

There are increasing amounts of work being carried out on skeletal material but not an enormous amount in Britain (with the exception of Stirling’s work on the Mary Rose skeletal material (1993)) or the Newport skeleton, especially where interpretation of musculoskeletal markers is concerned.

This work hopefully not only provides an interesting and informative view of the Newport skeleton, showing how this type of research can be utilised but also opens the door for further research to be carried out on the Newport skeleton and other British skeletal material. This work hopefully shows the importance of skeletal analysis in interpreting daily activity patterns, showing that it is no longer necessary to purely rely on experimental archaeology or analogy but instead information can also be gained from dated skeletal material and then used in various ways to further our understanding of the past including the utilisation of musculoskeletal assessment in conjunction with other types of archaeology.

Future studies that may provide support for the conclusions drawn here regarding the Newport individual may include cross-sectional studies (as mentioned in Steele 2000), where a cross-section of the bone is cut out and examined. Studies by Steele (2000) suggest that there are aspects of the cross-sectional shape and area which reflect handedness and activity patterns. However, this method would destroy the bones and so may not be possible or desirable. In this case, radiographic studies (for example, x-rays) could be undertaken. Reichel et al (cited in Steele 2000:310) found that there was a correlation between handedness and greater bone mineral density on the dominant side. Radiographic studies also support the statement that bone adapts to activity (ibid). Radiographic studies would provide a way to explore the internal structure of the bone without destroying valuable archaeological material.

Chapter 6: Conclusion

This dissertation had two aims-to assess the usefulness of skeletal indicators in determining robusticity and handedness in the case of the Newport skeleton and to use data obtained from the musculoskeletal assessment to comment on the possible lifestyle and activity patterns of the Newport individual.

This dissertation has achieved both these aims. From the musculoskeletal assessment of the Newport skeleton it is possible to say with certainty that the Newport individual was an extremely robust male, with taller than average stature-taller than both modern day and past populations.

It is likely that, as a male living in the Iron Age, the Newport individual would have undertaken heavy manual labour habitually, possibly on farms or hillforts in the local area or been a craftsman, possibly a blacksmith. Although it is not possible to assign a definite single occupation for the Newport individual, it is possible to suggest types of activity that are consistent with the musculoskeletal findings.

This dissertation, hopefully, has provided an interesting insight into a unique skeleton. It is not often that an Iron Age skeleton is found in Wales, and to find a skeleton truncated at the neck and knees is even more interesting! Often, the only questions asked when a skeleton is discovered is how old, what sex and cause of death. The opportunity to carry out the musculoskeletal assessment of the Newport skeleton and the writing of this dissertation has provided something unique to Wales, something more than the age and sex of the individual. While work on musculoskeletal markers and the interpretation of activity patterns has been carried out, work is relatively scarce and for all this study has established musculoskeletal markers and possible activity patterns for the Newport individual, the study is limited by lack of comparative material. It is not possible for example, to establish a trend for other Iron Age populations in Britain. However, this is in no way detrimental to this work which has shown the possibilities of musculoskeletal

assessment and inferred activity patterns for a remarkable Iron Age skeleton, providing a fascinating insight into the possible lifestyle of a unique Welsh enigma!

APPENDIX I

Appendix I

A full detailing of the measurements taken of the Humerii, Radii, Ulnae and Femurs in this study.

All bones were measured according to the method laid out by Bass (1995) and sliding callipers or a tape measure were used to gain the measurements. Measurements appear in both metric and imperial forms in the study.

The Humerus

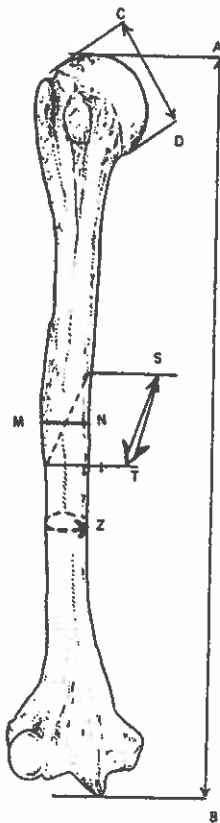


Plate 8. Measurements of the Humerus. (taken from Bass 1995:153)

Measurements used in calculations in this study.

A-B = Maximum Length.

C-D = Maximum diameter of the head

Z = Least circumference of the shaft.

The Radius

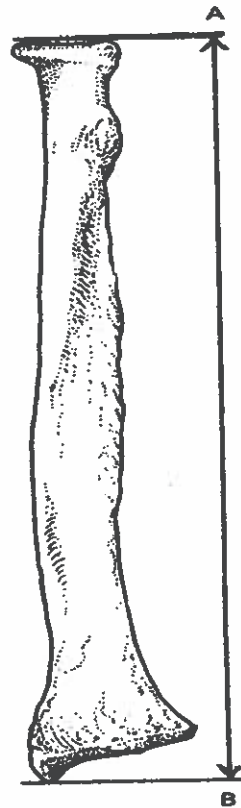


Plate 9. Measurements of the Radius (taken from Bass 1995:167)

Measurements used in calculations in this study.

A-B = Maximum length of radius

The Ulna

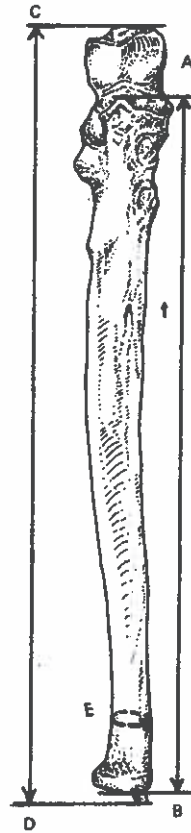


Plate 10. Measurements of the Ulna (taken from Bass 1995:175)

Measurements used in calculations in this study.

A-B = Physiological length of Ulna

C-D = Maximum length of Ulna

E = Least circumference

The Femur

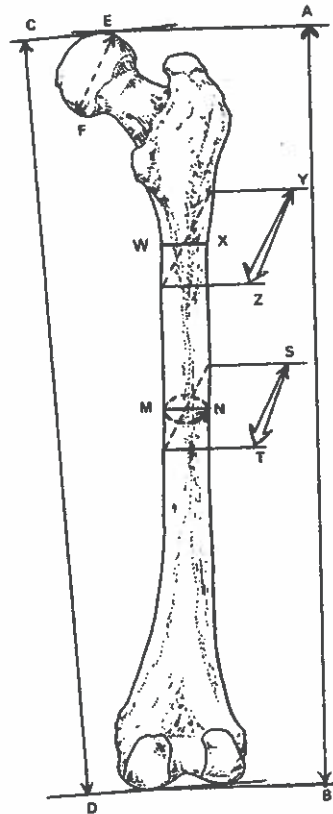


Plate 11. Measurements of the Femur (taken from Bass 1995:224)

Measurements used in calculations in this study.

A-B = Maximum Length

Details of how length and width measurements were taken of the musculoskeletal markers used in this study.

Musculoskeletal markers were measured using sliding callipers from the most proximal point of the marker to the most distal for the length and were measured at the widest point for the width. All measurements appear in mm.

APPENDIX II

Appendix II

Stature formulae and calculations for the Newport skeleton's right Femur and right Ulna.

Formulae used in this section are taken from Bass (1995: pp 233; 176; 152 & 173).
Measurements for height are given here in cm only.

Stature formula for a White male femur.

$$\text{Stature} = 2.232 (\text{max. length femur}) + 65.53 \pm 3.94$$

Calculation for the Newport skeleton.

$$\begin{aligned} 2.232 (46.0) + 65.53 \pm 3.94 \\ 106.72 + 65.53 \pm 3.94 \\ = 172.25 \pm 3.94 \end{aligned}$$

$$\text{Mean} = 172.25 \text{ cm}$$

$$\text{Range} = 172.25 - 3.94 = 168.31 \text{ cm (low)}$$

$$172.25 + 3.94 = 176.19 \text{ cm (high)}$$

Stature formula for a White male ulna.

$$3.76 (\text{max. length ulna}) + 75.55 \pm 4.72$$

Calculation for the Newport skeleton.

$$\begin{aligned} 3.76 (27.6) + 75.55 \pm 4.72 \\ 103.78 + 75.55 \pm 4.72 \\ = 179.33 \pm 4.72 \end{aligned}$$

Mean = 179.33 cm

Range = 179.33 – 4.72 = 174.60 cm (low)

= 179.33 + 4.72 = 184.05 cm (high)

Robusticity Index formula and calculation for the Newport skeleton (left humerus).

Robusticity Index = $\frac{\text{least circumference of shaft} \times 100}{\text{maximum length of humerus}}$

**Robusticity Index for the Newport skeleton = $\frac{71 \times 100}{322}$
= 22.02**

Caliber Index formula and calculation for the Newport skeleton.

Caliber Index = $\frac{\text{least circumference} \times 100}{\text{physiological length}}$

**Caliber Index for the Newport skeleton (right ulna) = $\frac{51 \times 100}{276}$
= 18.47**

**Caliber Index for the Newport skeleton (left ulna) = $\frac{45 \times 100}{264}$
= 17.04**

Bibliography

Barker, C. 2001 A Fascinating Ship. www.thenewportship.com/ship.index.html. Accessed March 2nd 2006

Bass, W.M. 1995 **Human Osteology: A Laboratory and Field Manual 4th Edition** Missouri Archaeological Society: Missouri

Bemben, D.A., Feters, N.L., Bemben, M.G., Navabi, N. & Eunsook, T. KOH. 2000 Musculoskeletal responses to high- and low-intensity resistance training in early post menopausal women. **Medicine & Science in Sports & Exercise** 2000; 32(11): 1949-1957

Brewer, R.J. 1993 **Caerwent: Roman Town** Cadw: Cardiff

Bridges, P.S. 1989 Changes in Activities with the Shift to Agriculture in the Southeastern Unites States. **Current Anthropology** 1989; 30:385-393

Churchill, S.E. & Formicola, V. A Case of Marked Bilateral Asymmetry in the Upper Limbs of an Upper Palaeolithic Male from Barma Grande (Liguria), Italy. **International Journal of Osteoarchaeology** 1997; 7:18-38

Cox, M. & Mays, S. 2002 **Human Osteology in Archaeology and Forensic Science** Greenwich Medical Media Ltd: London

Davis, P.R. 1992 **Historic West Wales** Christopher Davies Ltd: Swansea

Hawkey, D.E. & Merbs, C.F. 1995 Activity-induced Musculoskeletal Stress Markers (MSM) and Subsistence Strategy Changes among Ancient Hudson Bay Eskimos. **International Journal of Osteoarchaeology** 1995; 5: 324-338

Inskeep, R. 2001 Some Notes on Fish and Fishing in Africa. Pp 63-73 in Milliken, S. & Cook, J. 2001 **A Very Remote Period Indeed: Papers on the Palaeolithic presented to Derek Roe** Oxbow Books: Oxford

Kannus, P., Haapasalo, H. et al. The Site Specific Effects of Long-term Unilateral Activity on Bone Mineral Density and Content. **Bone** 1994; 15:279-284

Knüsel, C. 2000 Bone Adaptation and its Relationship to Physical Activity in the Past in Cox, M. & Mays, S. 2000 **Human Osteology in Archaeology and Forensic Science** Greenwich Medical Media Ltd: London

Larsen, C.S. 1997 **Bioarchaeology: Interpreting behaviour from the human skeleton** Cambridge University Press: Cambridge; New York & Australia

Lee, R.B. & Devore, I. 1968 Problems in the Study of Hunter-Gatherers. Pp 3-13 in Lee, R.B & Devore, I. (Eds) 1968 **Man the Hunter** Aldine: Chicago

Mays, S. 1998 **The Archaeology of Human Bones** Routledge: London & New York

Mays, S., Steele, J. & Ford, M. 1999 Directional Asymmetry in the Human Clavicle **International Journal of Osteoarchaeology** 1999; 9: 18-28

McMinn, R.M.H, Hutchings, R.T., Pegington, J. & Abrahams, P. 1993 **A Colour Atlas of Human Anatomy Third Edition** Wolfe Publishing: London

Mytum, H. 1987 **Excavations at the Iron Age Fort of Castell Henllys in North Pembrokeshire** Department of Archaeology University of York: York

Peterson, J. The Natufian Hunting Conundrum: Spears, Atlatls or Bows? Musculoskeletal and Armature Evidence. **International Journal of Osteoarchaeology** 1998; 8:378-389

Pryor, F. 2004 **Britain B.C.: Life in Britain & Ireland Before the Romans** Harper Perennial: London

Reynolds, P.J. 1987a **Ancient Farming** Shire publications Ltd: Aylesbury

Reynolds, P.J. 1987b **Iron Age Farm: The Butser Experiment** British Museum: London

Robb, J.E. The Interpretation of Skeletal Muscle Sites: A Statistical Approach. **The International Journal of Osteoarchaeology** 1998; 8:363-377

Seireg, A. & Arvikar, R. 1989 **Biomechanical Analysis of the Musculoskeletal Structure for Medicine & Sports** Hemisphere Publishing Co: New York; London; Washington & Philadelphia

Sproston, K. & Primatesta, P. (Eds) 2003 **Health Survey for England 2003 Volume 3: Methodology & Documentation** The Stationary Office: Great Britain

Steele, J. 2000 Skeletal Indicators of Handedness in Cox, M. & Mays, S. (Eds) 2000 **Human Osteology in Archaeology and Forensic Science** Greenwich Medical Media Ltd: London

Steen, S.L. & Lane R.W. Evaluation of Habitual Activities among 2 Alaskan Eskimo Populations based on Musculoskeletal Stress Markers. **International Journal of Osteoarchaeology**. 1998; 8:341-353

Stirland, A.J. Asymmetry and Activity Related Change in the Male Humerus. **International Journal of Osteoarchaeology**. 1993; 3:105-115

Stirland, A.J. Musculoskeletal Evidence for Activity: Problems of Evaluation. **International Journal of Osteoarchaeology** 1998; 8:354-362

Walker, P. 2005 American Association of Physical Anthropologists. www.physanth.org.
Accessed March 2nd 2006

Warwick, R. & Williams, P.L. (Eds) 1973 **Gray's Anatomy 35th Edition** Longman:
Edinburgh

Weiss, E. Understanding Muscle Markers: Aggregation and Construct Validity.
American Journal of Physical Anthropology 2003; 121: 230-240

Wilczak, C.A. Consideration of Sexual Dimorphism, Age and Asymmetry in Quantitative
Measurements of Muscle Insertion Sites. **International Journal of Osteoarchaeology**.
1998; 8:311-325

Williams, G. 1985 **Fighting and Farming in Iron Age West Wales** Dyfed
Archaeological Trust Ltd: Dyfed

The Newport Skeletal Remains

A Bio-Archaeological and Cultural Analysis



Alison Bennett

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A Bio-Archaeological and Cultural Analysis

Alison Bennett

*Dissertation submitted in partial fulfilment of a B.A. (Hons) in
Archaeology, University of Wales, Lampeter*

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Abstract

In 2002, articulated human remains were excavated from beneath support timbers of a medieval ship dendro-chronologically dated to 1467AD. Although proximately close to the ship, archaeological and geological evidence could not positively date the skeletal remains to the 15th century. Examination of the skeletal context, bone taphonomy and metric and non-metric analysis were undertaken to attempt to infer a biological identity, including racial origins and period of deposition. Although racial affinity and date of death were inconclusive, a cultural inference of the remains centred on an inferred Welsh racial affinity in keeping with the time of the ship abandonment in 1467 AD based on the archaeological evidence and historical texts.

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Introduction

In 2002, during the construction of an Arts and Theatre centre on the site of Moderator Wharf, Newport, Wales, human skeletal remains were excavated from under support timbers of a 15th century medieval ship located within an original tributary of the River Usk.

At the time of writing this dissertation, very little research had been published on the excavation and no osteological examination had been carried out on the skeletal remains. The purpose of this dissertation was to attempt a biological and cultural inference on the person who lay close to the medieval ship. It was clearly understood that this method of research would result in many questions concerning the archaeological context of the remains being unanswered at this time. Therefore, the key questions of this paper were; was the individual connected to the ship in any way? Was it possible to infer a sex, age and height for the individual? More importantly could a racial affinity and date of death be inferred? And finally, with the skeletal analysis complete, was it possible, from the information gathered, to construct a cultural identity of the individual?

By attempting to infer a biological and cultural identity it was important to question the deposition and taphonomic processes of the skeleton, especially as the remains had been excavated from a complicated fluvial environment, but in which the skeleton had remained articulated and in relatively good condition. A thin section from the femur was taken to examine the bone structure and to infer how rapidly and under what conditions the person had died. Once this process had been completed, metric and non-metric analysis were undertaken on the pelvis and long bones in an attempt to infer

a sex, age, height, race and date of death, or in other words, a biological identity. It was hoped that further analyses of the bones would reveal additional information concerning the individuals' lifestyle, including general health, pathologies and occupation. In order to achieve these inferences, the measurements taken from the pelvis and long bones were compared with a range of published measurements from archaeological samples. No prior assumptions were made about the individual's identity before looking at the metric and non-metric observations.

Once these observations were made, it was considered important to take the study one stage further and attempt a cultural understanding of the individual within the person's contemporary environment. As the result of the radiocarbon date of the skeleton was still in the process of being established, it was decided to centre the cultural analysis around the abandonment date of the 15th century medieval ship, which was also one of the possible dates established from the biological investigation.

I have recognised from the beginning of this dissertation, that I have been offered research on original, unstudied material from a very important archaeological site. The research within this dissertation has been purposefully limited to concentrate on inferring a biological identity of the Newport skeleton and placing it theoretically within a cultural context. There are many aspects surrounding the excavation at Newport, including the skeletal remains, which have had to be put on hold at this time and await further research at a later date. I am fully aware that research surrounding the stratigraphy of the river Usk, the *in-situ* context of the remains and the excavation procedure need further exploration, but felt they were beyond the limits of this dissertation. In addition, some of the procedures attempted within

the biological analysis were unfamiliar techniques and will receive further investigation in the near future.

Chapter 1

Archaeological Context of Remains

1. Location and Excavation of the Skeletal Remains

In 2002, during the construction of an Arts and Theatre centre on the site of Moderator Wharf, Newport, Wales, human skeletal remains were revealed laying beneath support timbers of a medieval ship located within an original tributary of the River Usk (NRG ST 31286 88169) (Nayling 2003: 153). At the time of writing this dissertation, very little research on the stratigraphy of the tributary, the excavation of the ship and the excavation of the remains have been published. Therefore, the information written here is based on provisional information provided by the excavators and so is liable to change in the future. Although there are many interesting questions concerning the ship and its archaeology, this chapter will concentrate on the archaeological context of the human remains within an ambiguous stratigraphy where the overlying sediment predated the bones.

1.1. Topography and Geology of the Excavation

Today the River Usk runs downs from the Black Mountains through south Wales through the Gwent Levels and continuing until it reaches the Severn Estuary (fig 1.1.SELRC 2003, Manning 1981). Paleo-environmental analysis has yet to be started on the area from where the ship was excavated and a detailed summary of the stratigraphy still awaits publication. For this reason, the discussion of the context in which the bones lay at Newport, described here, are preliminary. It is understood that the Newport Ship occupied a small inlet on the right bank of the River Usk. A small river channel

running over the underlying bedding of Mercian mudstone (formally known as Keuper Marl clay) probably formed this inlet. The basal deposit of this channel comprised of a mix of degraded or eroded Mercian mudstone and alluvial silty clays (Nayling 2004 pers comm.). It was within these basal deposits that the human remains were deposited.

Previous excavation in an area close to the bow of the ship but outside the cofferdam (discussed in 1.2.) undertaken by Oxford Archaeology Unit (2003) has revealed a complicated stratigraphic sequence; there is an accumulation of a series of alluvial sediments, comprising of natural clay silts and alluvial clay, and there is evidence of slag deposits and the discarding of metal working remains (Camidge & Brown 2003).

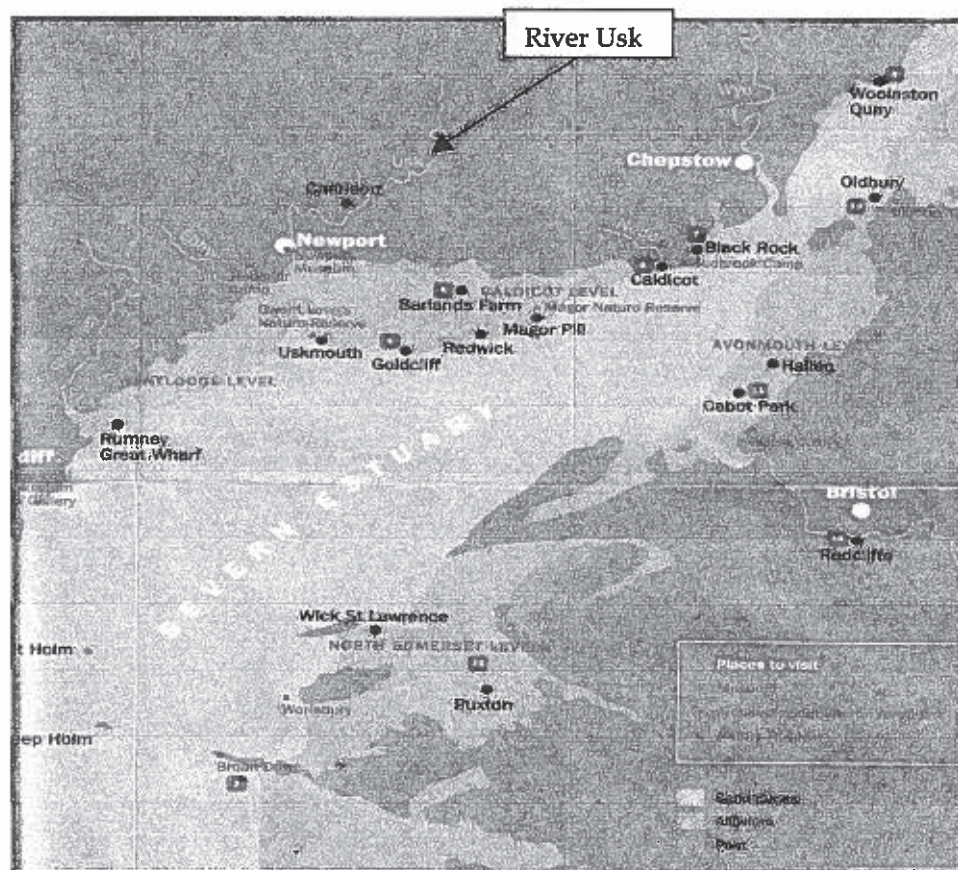


Fig 1.1
Map of the Severn Estuary Levels showing the river Usk running through Newport and into the Severn Estuary (SELRC 2003)

The deposits within this channel suggest that although it would have been a small stream that ran into the River Usk, the inlet would still have been affected by strong tides and even the occasional flash flood, resulting in a solid base of the calcareous clay Mercian mudstone (Nayling 2004 pers comm.). The Mercian mudstone bedrock, dating to the Triassic period, was gradually eroded and mixed with the seawater creating a mud basal. This basal was then overlaid with alluvial drift deposits associated with the River Usk (Camidge & Brown 2003). It was this Mercian mudstone basal from the channel that formed the context layer for the ship and human remains also indicating an historic division between the river and dry land at that time (Nayling 2004 pers comm.).

1.2. Newport Ship – Setting the Scene

Prior to the discovery of the ship, a metal cofferdam had been constructed 8.6 m below the modern ground surface to contain the new foundation area and concrete piles that were being set in to place in preparation for the construction of the Arts and Theatre Centre (Camidge & Brown 2003). Within the area protected by the cofferdam, groups of waterlogged timbers were unexpectedly discovered when heavy machinery lifted the fluvial sediment whilst digging the orchestra pit. Archaeologists contracted by Glamorgan-Gwent Archaeological Trust (GGAT), who were on a watching brief during this phase of the construction, recognised the exposed timbers to be part of an articulated ship (Howell 2004). Unfortunately, the cofferdam had cut through the bow and stern of the ship and the piles had caused damage to some of the main hull timbers. Once the alluvial deposits had been removed and timbers were exposed, the machine digging was cancelled and excavation continued by hand (Camidge & Brown 2003).

Marine archaeologists who oversaw the excavation and preservation of the ship timbers, in consultation with GGAT, used dendrochronology dating to obtain a 15th Century date for the ship. It has been hypothesised that the ship had been brought into a pre-constructed jetty and laid starboard side against a framework of timbers that had been felled in the winter of 1467AD (Nayling 2003). These timbers had been positioned against the edge of the riverbank for the purpose of supporting the ship in preparation for repair. After abandonment and either during or following accumulation of the overlying sediment the ship eventually partially collapsed (Nayling 2003).

The shape and size of the ship suggests it was built in the north Europe 'clinker-built' tradition similar to ships used during the Viking era. The ship measured over 23m in length, and as discussed earlier, was cut through at the stern and bow by the cofferdam. The archaeological evidence recovered from the ship suggests it was used as a merchant-trading vessel around Ireland, Wales, France and Portugal. Artefacts excavated from the ship have included 15th century Spanish and Portuguese coins, Portuguese Merida Ware pottery, stone cannon balls and engraved brass straps. In addition, organic items including leather shoes plus fragments of textiles, wool and wooden combs were found (Howell 2004). The possible relationship of the individual with this trading route will be discussed further in chapter 6.

It is understood that all details of the ship's excavation were planned, recorded and photographed. The excavation archive records are now being held with Newport City Council. This area of research is too large for discussion here and so will not be included within this

dissertation, which centres on the biological and cultural identity of the human remains.

1.3. Location of Skeletal Remains

The skeletal remains were discovered at 6.3 meters OD, beneath the support timbers in a gap created between the ship and the riverbank and excavated by archaeologist Hefin Meara. In relation to the ship this placed the skeletal remains beneath the starboard side at approximately F35 S25 (F35 = 35 frames along from the front of the ship and S25 = 25 planks up from the bottom of the ship) within older Mercian mudstone clay (Nayling 2004 pers comm.). As figure 1.2 indicates, the laying of the timbers against the riverbank created a gap in which the body was able to fall into or be deposited by a high tide. Other deposits around the skeletal remains suggest human activity such as metalworking, indicated by dumps of iron slag (Camidge & Brown 2003).

The property of the sediment in which the skeletal remains were located would have been similar to that of soft mud and therefore very difficult for anyone to get out of once they had fallen in. However, as the area was tidal it is also possible for the body to have been washed in on a high Spring tide either before, during or after the ship had been placed there for repair. This is an important point to be considered, as the stratigraphic position of the remains is an unreliable method of dating the individual. The stratigraphy of this channel is arbitrary due to the tide mixing with the Mercian mudstone, creating a layer of slurry, and therefore it is inevitable that the body sank down through the stratigraphy, postdating the mudstone above it (Nayling 2004 pers com.). Therefore, lying beneath medieval timbers does not automatically place the death of

the individual to the time of the ship repairs in 1467AD. It is well within the realms of possibility for the individual to be prehistoric as it is to be medieval or even more modern. Further analysis surrounding when the individual died will be discussed further in Chapter 6.

From the evidence of the photographs taken of the *in-situ* remains prior to excavation, it would appear that the body was articulated when it entered the water (Chamberlain 2004 pers comm.) rather than being a collection of bones that have been washed in by the tide and deposited in this location (Chaplin 1971). This is evident from the articulated position of the remaining bones within the sediment (see figure 1.3). This is an interesting point, as this area of River Usk is subject to strong tidal currents as well as high spring tides. Therefore, for the remains to be found in such a well-articulated position, the body of the individual must have sunk deep under the sediment prior to losing its soft tissue, away from the strong currents that would have displaced and destroyed all the bones. The records show that the skull, both tibiae and fibulae and feet have been displaced but the reasons for this are unclear and may be varied.

However, the effects of the tide can be seen from the position of the left humerus, which has been washed down and repositioned over the left femur. In addition both femora have been truncated above the epicondyle suggesting movement of the sediment in which the remains lay.

Although it would seem reasonable to assume the individual was somehow connected to this 15th Century Medieval ship, who maybe fell overboard and sank in the mud, it is quite feasible that the individual was not associated with the ship at all. It may have been

someone who lived or worked close to the river such as a farmer or town resident who accidentally slipped in many years before the wharf was even built.



fig 1.3.
Skeletal remains in-situ at Newport.
(Photography courtesy of Kate Hunter Newport Museum & Art Gallery).

The individual could even be prehistoric and associated with the river rituals that were taking place at that time. Essentially it is only with radiocarbon dating that a more precise date of when the individual died can be established. A thin slice from the femur will be sent to Beta Analytic for dating but a date will not be available for this dissertation. A 15th century radiocarbon date will inevitably open more questions as to whether or not this individual was associated with the ship but an early date is also possible.

1.4. Excavation and Storage of Skeletal Remains

Excavation within the vicinity of the cofferdam was limited to only directly under the ship in this area. This was due to restricted access because of the building works. Therefore only a small section was available to archaeologists for salvage excavation, as all other areas around the ship had been back-filled in preparation for construction. This limited space prevented further archaeological exploration beneath the ship. Indeed it was with great luck that the human remains happened to be located within this small area. Fortunately, many experienced archaeologists and GGAT were on site, resulting in the excavation of the human remains being so well carried out. By following excavation procedures, a plan of the remains was drawn up prior to their removal, a pictorial inventory and context sheets were completed plus *in-situ* photographs were taken to record the position of the bones (Bass 1995) (appendix 1 - 3).

As the remains lay in a sediment that had a clay-like texture, plus the fragile nature of the bones, four separate lumps of sediment containing post cranium bones were collected, each of which were then placed on a wooden board, wrapped in solid bandaging to safely contain the sediment and bones and were then covered in clear polythene. All packages were labelled and allocated a context number, with the long bones bagged and labelled separately. Ideally, the bones should have been handed over to an institution in order for the bones to be cleaned and cared for immediately (Bass 1995). Instead the remains were placed under the responsibility of the Newport City Council for storage until they were handed to the University of Wales, Lampeter for analysis (Hunter 2004). The storage of wet bone in damp sediment, in a heated office for a period of 2 years resulted in the sediment beginning to dry out and what

appeared to be fungus to begin to form on the bone (Coard 2004 pers comm.).

1.5 Summary

From the key issues that have been discussed in this chapter, the following suggestions on the relationship of the individual in the stratigraphy of the River Usk can be made:

- 1) A date cannot be established for the individual until the result of the radiocarbon analysis has been completed. The stratigraphy of the sediment produced inaccurate dating sequences.
- 2) Many specific and broad questions surround the archaeology and relationship between the human remains and the medieval ship. These cannot be answered until further research has been completed.
- 3) The body was articulated when it fell into the channel. This conclusion demonstrates there was no previous burial location on land and the bones were not moved and redeposited in the river.

Chapter 2

Taphonomy of the Bones

2. Taphonomy of the bones

The taphonomic history of the bones has greatly influenced their condition. Examining the various processes the bones had undergone revealed a great deal of information concerning the depositional process of the skeletal remains prior to excavation.

As confirmed in Chapter 1, the skeletal remains were discovered in an articulated position within sediment in the river Usk but what was not established was whether the individual had entered the water and drowned immediately or whether the individual had died first and then the body placed in the water sometime after death. Determining a biological and cultural identity to this individual must first start with answering questions concerning the deposition process of the skeletal remains. This chapter will show that by examining the taphonomic process of the bones, answers were revealed regarding how quickly the body entered the water after death, how the fluvial environment damaged parts of the bones and how the sediment conditions kept the rest of the bones in a relatively good condition.

2.1. Weathering Effect on Newport Skeletal Remains

'If primary weathering can be distinguished from transport abrasion and diagenetic effects, then primary weathering can give specific information concerning surface exposure of a bone prior to burial and the time period over which bones accumulated' (Behrensmeyer 1978: 161).

The rationale of examining the damage to the bones prior to measurement was to ascertain what taphonomic processes they had undergone during deposition in to the River Usk. Chapter 3 will outline in detail which bones were excavated and their condition but for the purpose of this chapter, the damage to the bones is concentrated along most of the ossification areas, resulting in the shaft of the long bones being in good condition. An example of this can be seen in figure 2.1, where, although the midshaft of the femur is solid, the head has broken away from the neck along the epiphyses.



figure 2.1

Damage to the proximal left femur resulting in the head being broken off along the epiphysis

Damage was found on other parts of the skeletal remains, such as the right pelvis (figure 2.2) where the fragile parts such as the iliac crest and pubis had broken away.

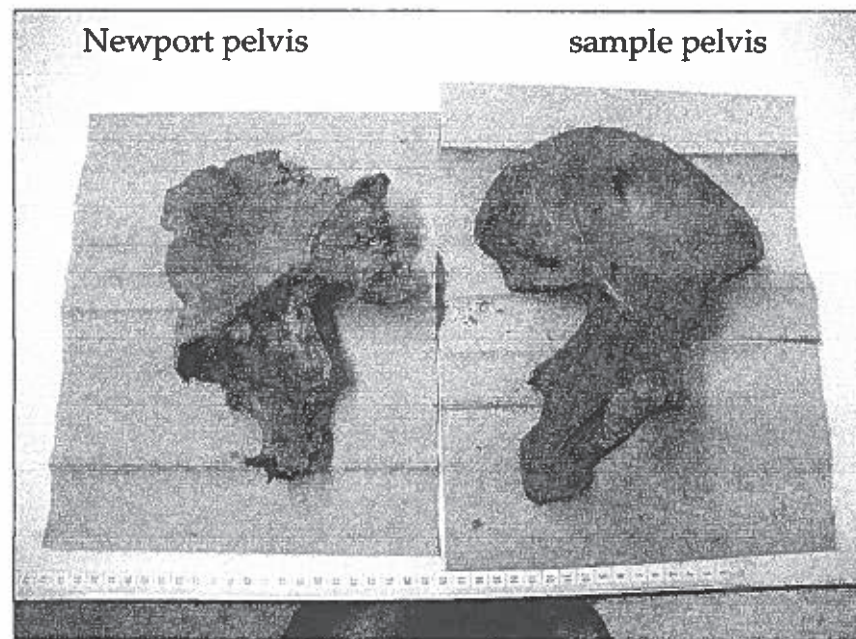


figure 2.2 Damage to the Newport right pelvis (right) with the iliac crest, the articular surface and pubis broken next to a laboratory sample

A fundamental understanding of why the bones had been well preserved with damage concentrated around the fusion areas needed to be understood before inferences could be made about the biological identity of the individual.

The specific damage could have been due to incomplete skeletal ossification, which would lead to questions about the age of the individual at death, or just as likely, weathering processes, which would lead to questions concerning where the individual died and how the body came to be laying in the bottom of the river. In addition, this skeleton was found articulated *in-situ*, which is indicative of the body being buried immediately or very soon after death. An alternative suggestion, the bones' being exposed on land after the soft tissue had rotted away and then being deposited in the water, does not appear to occurred (Chamberlain 2004 pers comm.).

Examination of the femora, humerus, pelvis and phalanges revealed that most of the bones had their severest damage around the ossification areas. By looking at the pictorial inventory drawn on site (appendix 1), it would appear that there had not been any specific damage centred on certain areas of the skeleton i.e. just the left side or just the legs, but had centred on the weakest parts of the bone i.e. the ossification or fusion areas.

This could be seen on many of the long bones, such both femora heads and greater trochanter breaking off at the epiphysis (see figure. 2.1). The radii and ulnae also had damage to the proximal and distal ends, with the styloid and semilunar notch missing. However, evidence of another type of damage had occurred at the distal femora. Both bones had been truncated above the epicondyle area. This may have been due to the overlying heavy sediment moving slightly and consequently breaking the femora. It may also have been this process that carried away the fibulas, tibiae and feet bones.

Due to the destruction of the bones being concentrated around the ossification areas it was suggested that the skeletal remains could belong to a young individual, possibly in their late teens. As ossification rates vary throughout the growth of the skeleton and many of the epiphyses are still fusing during the teenage years and even into the early 20's (Bass 1995). McKern and Stewart (1957 cited Bass 1995: 220) have shown ossification in many of their samples remained incomplete until 22 years of age. This could be one explanation for the damage to the bone ends. If death occurred during the fusion process then it is possible to place the age of death of the individual during their late teenage years. This would result in the fusion areas being the weakest points of the bones and the first to be lost through erosion, weathering or decay.

Although further examination was to show that ossification had actually completed and the skeletal remains were in fact from a mature individual, it was important to note this initial observation, as this was a key aspect of formulating a biological identity to the individual. Preliminary examination of the bone also suggests there was no sign of any pathology that might have prevented fusion from occurring when the individual was alive as the rest of the bones were solid and intact (Chamberlain 2004 pers comm.). It was concluded, therefore, that the damage must have occurred due to being deposited within a fluvial environment (Coard 2004 pers comm.).

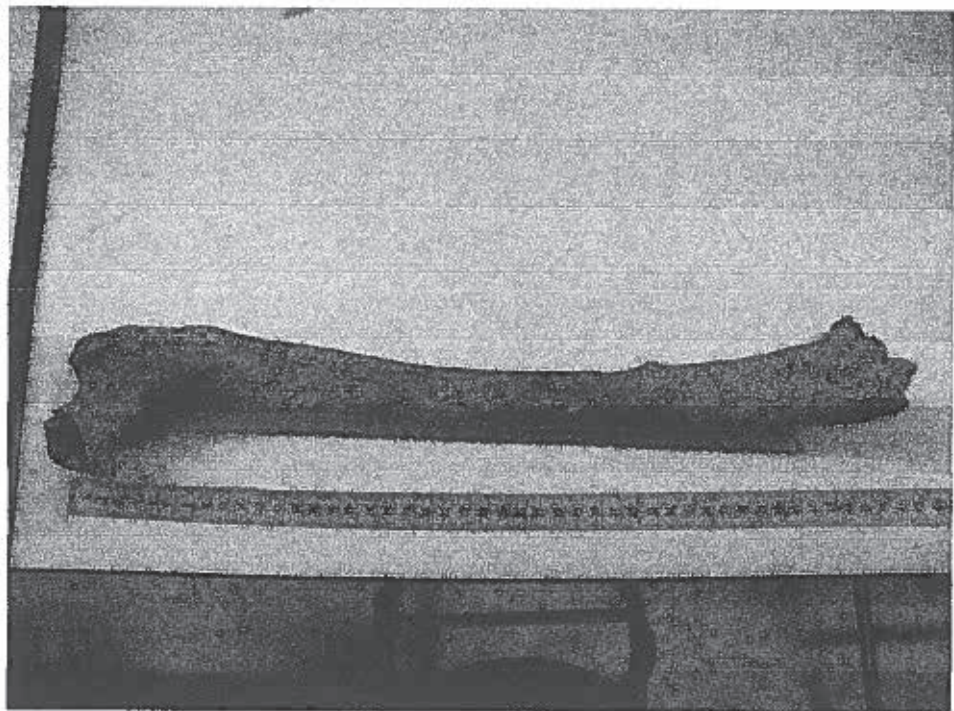


Figure 2.3

Right femur with damage to the distal shaft, the greater trochanter and the proximal head

Detailed examination of the long bones revealed a smooth midshaft with only a few multi-directional striations. The striations, visible under the microscope, were shallow and the same colour as the bone. This is indicative of rapid burial in a fine-grained environment rather than being abraded by pebbles due to being washed back and forth

on a river floor (Chamberlain 2004 pers comm.). There was no cracking visible along the striations and there had been no flakes of bone detached, which would indicate initial dry weathering or exposure on land before deposition (Shipman 1993). With reference to Behrensmeyer's (1978) weathering stage chart, it is proposed these bones should be classed as stage 0 due to their overall good condition with collagen present (smelt when taking the thin section off the femur) and a lack of cracking or flaking along the midshaft. Stage 1 of Behrensmeyer's (1978) weathering chart suggests the bones should display cracks parallel to the fibre structures and mosaic cracking of the bone but none of these were visible (Lyman 1994).

The evaluation of weathering stage 0 to the bone condition confirmed that there would have been rapid burial of the body into the fluvial environment with no exposure of the bones to dry weathering. However, questions remained concerning how the damage to the ossification area, in particular the proximal humerus, the proximal ulnae and radii, the iliac wings and vertebrae occurred. Interestingly, the condition of the metacarpals and phalanges of the left hand did not appear weathered and this may be because they had been lying underneath the pelvis within the sediment and therefore protected further from the full force of the water erosion.

Examination of the distal humerus and proximal femoral under the microscope indicated that the bones had not been subjected to carnivore gnawing as there were no teeth marks indicative of chewing. The bone still contained marrow, which would have attracted carnivores had the bones been lying on the surface, but as rapid burial had occurred; no attacks by animal had taken place.

As ossification confirmed that fusion had occurred on all the ossification centres during the life of the individual, it was concluded that erosion caused the damage to these areas from the action of the river and attack from bacteria living in the water. The evidence for this could be seen in the make up of the bone. The cortex within the midshaft of the long bones was thick and dense, but the cortex at the ends of the bones was thinner producing a spongy bone, which decayed rapidly in the fluvial environment. These weakest parts of the bones, where ossification had already occurred during life, had become subjected to the fluvial tidal and bacterial action of the river causing them to rot away.

2.2. Sediment Micro-organisms

Once the body had been deposited into the wetland environment, the decomposition of the soft tissue had begun almost immediately. The decaying process usually consists of two processes, autolysis and putrefaction. Autolysis being the process whereby tissue degrades through the attack of enzymes without bacteria and putrefaction being the process where enzymes produced by the bacterial micro-organisms invade and destroy the soft tissue (Chamberlain 1994 pers comm., Mays 1998). Examination of the 50 μm thin slice suggests that putrefaction did not occur as the bone appeared almost fresh with very little damage to the osteons. This would suggest that the body had had a rapid burial in anaerobic conditions, thereby destroying the bacterial micro-organisms and preventing putrefaction from taking place. This lack of bacterial attack was also evident from the high levels of collagen still present in the bones, smelt during the cutting of the thin slice.

The lack of bacterial attack is indicative of slow decay often found in cold anaerobic conditions such as fluvial sediments. Temperature has an immense influence over the speed at which the bones deteriorates and micro-organisms in the sediment are usually more active in warmer temperatures thereby increasing the rate of decay. Consequently they tend to be less active or non-existent in cooler climates (Mays 1998). Temperatures taken from three locations in the river Usk, between January 2002 and November 2004 have produced three temperatures: 12.16°, 10.79° and 12.10°. Together these figures generate an overall average temperature for the river Usk as 11.68° (Servini 2005). The cool constant temperatures found below the sediments of the River Usk had slowed the decay process down. This slow decay is also indicative of deep burial, where the bones have not been subjected to fluctuating temperatures and exposure such as those found in shallow graves (Chamberlain 2004 pers comm. Coard 2004 pers comm.). Nielsen-Marsh *et al* (2000) have investigated the relationship between bone collagen decomposition and burial temperatures. Their results suggest that with the absence of mineral dissolution and its resulting microbial decomposition there is little loss of collagen in temperate climates, whereas in warmer climates there are significant losses.

Once the soft tissue has decomposed, bones buried in ambient and hot climates are subjected to attack from micro-organisms, which inevitably results in the demineralisation of the bone (May 1998). As bone is constructed from both mineral (calcium, phosphorus and oxygen) and organic (oxygen, carbon, nitrogen and hydrogen) phases plus trace elements (copper, zinc, manganese and iodine) it is the character of the sediment that determines the survival or deterioration of bones within the burial (Chamberlain 1994 pers comm.). In dry burial environments many micro-organisms, including fungi, bacteria and algae move between the bone and the

soil breaking down the collagen, resulting in brittle bones, which in turn leads to acidic dissolving of the bone mineral (Mays 1998).

Instead, the anaerobic burial environment of the River Usk slowed the process of the collagen mineralising thus preventing micro-pores greater than 8µm, from being attacked. Due to the micro-pores large size, attack was prevented from other bacterial and fungal exoenzymes (Nielsen-Marsh *et al* 2000). The transition from healthy bone into decayed bone would also have initiated a loss of lipid content and an increased porosity resulting in the bones taking on the red colouring of the Mercian mudstone. The bones then lost their waxy appearance and become increasingly fragile. The more fragile bones, such as the vertebrae, the long bone ends and the pubis, were more prone to decay and resulted in their poor survival condition.

Few bacteria are located in anaerobic muddy silts found in rivers and those present do not usually eat collagen (Chamberlain 2004 pers comm.). This explains the presence of organic collagen, which could be smelt when cutting a thin section off the left femur. It is the large amount of collagen present in these bones has prevented the bones from becoming too brittle (Chamberlain 2004 pers comm. Coard 2004 pers comm.).

A major influence on the decay of the bones was the pH value of the River Usk sediment and it is well documented that any soil over pH7 is regarded as alkaline and under pH7 as acidic. Contact with the Environment Agency has shown that the Mercian mudstone at the mouth of the River Usk is classed as a non-aquifer and the agency is not monitoring the groundwater quality in this area (Servini 2005). Research conducted by Gordon and Builstra (1981 cited Mays 1998) has concluded that the destruction of the bone increases due to the soil pH decreasing and becoming more acidic. This results in the

major bone mineral hydroxyapatite becoming increasingly soluble, especially in pH values below 6. This is consistent with archaeological studies of sites such as Sutton Hoo, where the soil acidity, between pH 3.8 and 4.9, resulted in no preservation of bone in the burials (Mays 1998). However, the anaerobic waterlogged sediments tend to impede the rate of decay of organic material and this would explain the comparatively good preservation of the bones plus the presence of organic material located around the bones (Howell 2004, Grant *et al* 2002).

In wetland areas, the medium of water allows the transport of ions between the bones and sediment increasing the rate of bone chemical decay. As Nielsen-Marsh *et al* (2000) discuss, bone buried in waterlogged environments are affected by dissolution, microbiological attack and ion exchange and therefore any drop in the Ca^{2+} content plus an increase in water pressure will result in a higher rate of mineral dissolution and consequently a decrease in bone survival. Excavations from a Saxon site in Mucking, England reveal poorly preserved bones that were laying in free-draining soils, as the water had almost completely drained out the bone mineral (Mays 1998).

Nielsen-Marsh *et al* (2000) have investigated the effects of hydrological environments on bone. They concluded that 'sluggish' water environments, where the soil is saturated, decreases dissolution of bone mineral and minimizes the effects on the bone caused by variable water pressure. However, bone that is buried in an environment where the water velocity is variable, usually close to the water surface, will gain an increase in bone porosity (Nielsen-Marsh *et al* 2000). Examination of the bones has revealed they do not have great porosity, however, they have taken on the colouring of

the sediment in which they lay. This colouring ranges from orangey brown to red.

2.3 Microscopic Analysis

As buried bones are usually subjected to decay from micro-organisms living in the sediment, any deterioration of the bones would be visible on the thin section cut from the femur. The microscopic analysis of the bone helped to confirm the inference that the individual had died in the anaerobic conditions very quickly after falling into the river (Chamberlain 2004 pers comm.). Bone production by osteoblasts lay down a protein template within lamellar bone and this layering effect represents a histological feature in the growth of the bone. This continuing process of bone growth through the destruction and reproduction of osteons, results in a histologic chronology of the bone (see figure 2.1). The older the bone is, the greater production of osteons, osteon fragments and lower mineral density (Ortner 1976, Ericksen 1991).

The thin section from the Newport individual examined under a 10x magnification polarizing lens microscope, enabled identification of small amounts of mineralising on the outside of the bone which lacked magnesium, confirming that putrefaction had not taken place. However, overall the bone displayed healthy, fresh osteons that showed no signs of decay (Chamberlain 2004 pers comm.)

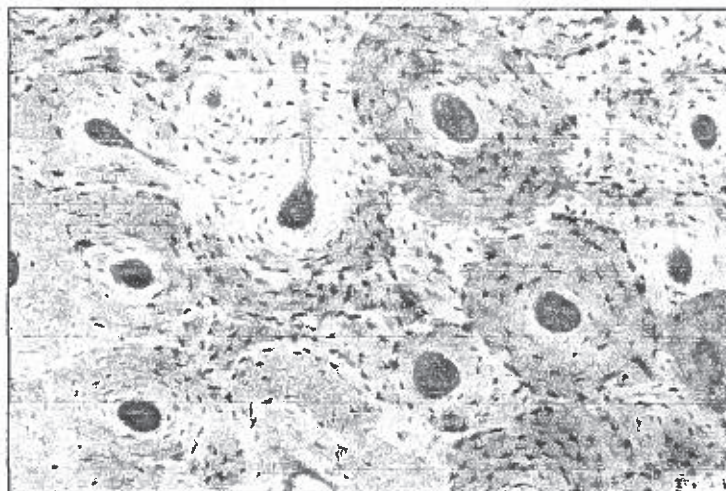


figure 2.4. Thin section from the Newport individual displaying healthy bone with osteon production and no destruction

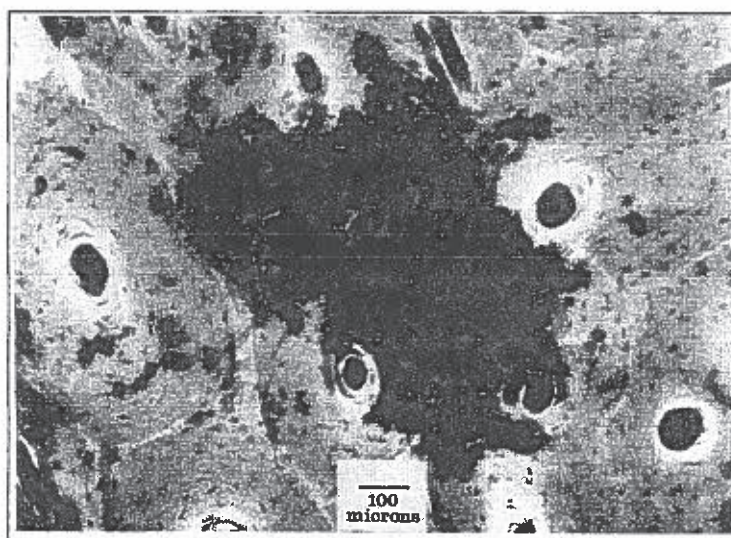


figure 2.5 Bone showing destruction of its osteonal structure. The dark area, centre, is a large area of bone destruction (Mays 1998: 20)

Figure 2.4 and 2.5 compares the thin section of the Newport individual with no decay destruction with one that identifies area of destruction around the osteons (the black parts) where the decay process has begun (Mays 1998). This confirms Stout & Teitelbaum (1976) suggestion that the level of preservation of bone is not affected by length of deposition time but the sediment conditions. However, the histological features are better preserved in non-decalcified bone such as the Newport bones.

2.4 Summary

From the key issues discussed in this chapter, the following inference can be made from looking at the taphonomic processes the bones have undergone:

- 1) The individual died shortly before or after falling into the water where the rapid cooling and deoxygenating conditions prevented putrefaction decay.
- 2) Fluvial weathering and decay is most likely to have caused the damage to some parts of the bones opposed to carnivore or bacterial influence.
- 3) The good preservation of the bones that did survive, weathering stage 0 (Behrensmeyer 1978), is due to the constantly cool, anaerobic wet environment.

Chapter 3

Preparation of Bones for Analysis

3. Preparation of Bones for examination

Prior to any attempt at a biological identity the bones excavated at Newport had to be prepared, including cleaning and drying, correct identification, completing an inventory and measuring them. At all times during this process, latex-free gloves were worn and the bones were securely stored within the laboratory to prevent any DNA contamination. No visitors were allowed to touch the bones while they were being examined and at the end of the process the bones were stored away in a locked cupboard.

3.1. Cleaning the bones

'...the samples are first excavated and handled using protective gloves, and are never washed. Clean airtight containers are used to transport and store the samples ...and they are stored in a cool dark place such as a refrigerator' (Chamberlain 1994: 55).

As discussed in chapter 1, the excavated human remains had been stored within a Newport County Council office wrapped in cellophane. The combination of wet sediment sealed in plastic and stored in a warm environment facilitated the partial drying of both the sediment and exposed long bones. The damp atmosphere created within the wrapping encouraged the growth of mould to form along the bone striations. During transportation of the remains, they were wrapped in wet bandaging that shrank once it had dried. Unfortunately, the bandaging had shrunk around the exposed pelvic

wings, causing damage the iliac crest. In hindsight it may have been better to place the lumps of sediment on to pieces of foam and place them within plastic containers. Once the remains arrived at the University of Wales, Lampeter, the cellophane was removed and the sediment was gently sprayed with water until the decision was made to clean and examine what had been excavated. The long bones were looked at first as they had been packed separately from the lumps of sediment and were the easiest to identify and least fragile of all the remains (Coard 2004 pers comm.).

The initial examination of the long bones and one block of sediment resulted in the following conclusions being made - all the long bones were fairly complete and the body of the bones appeared to be solid with a reasonably good surface texture visible (Coard 2004 pers comm.). Most of the bones were encrusted with sediment but this was not uniformly long the shaft and situated mainly at the ends. Both the left and right innominates were fragile but the right side was strong enough to be removed from the sediment for examination although too fragile to be cleaned with anything more than a soft toothbrush.

3.2 Methodology of Cleaning Process

Care was taken throughout this process to protect the bones from any further damage. An important consideration at this cleaning stage was the preservation of a sample of the sediment, in order for an organic analysis to be carried out at a later stage. Organic matter such as fish bones, plant macrofossils and charcoal might be caught within the sediment and it was necessary, therefore, to use 500 μ & 250 μ sieves to prevent fragments being washed away (Coard 2004 pers comm., Bass 1995). The cleaning methodology used on the large

Mercian mudstone blocks (see figure 3.3) was a gentle stream of warm water over the sediment to allow it to slowly break up. It was suggested that if any of the sediment was resistant to being broken up then diluted acid could be used, however, this proved unnecessary, as the sediment was very fine. Samples of the sediment were later sent to Kate Burrow (plant macro and pollen specialist) and Sue Bates (forams - micro calcium vertebrates specialist) both at the University of Wales Lampeter for further analysis (Coard 2004 pers comm.). The results of these analyses have not yet been published and will not to be discussed within this dissertation.

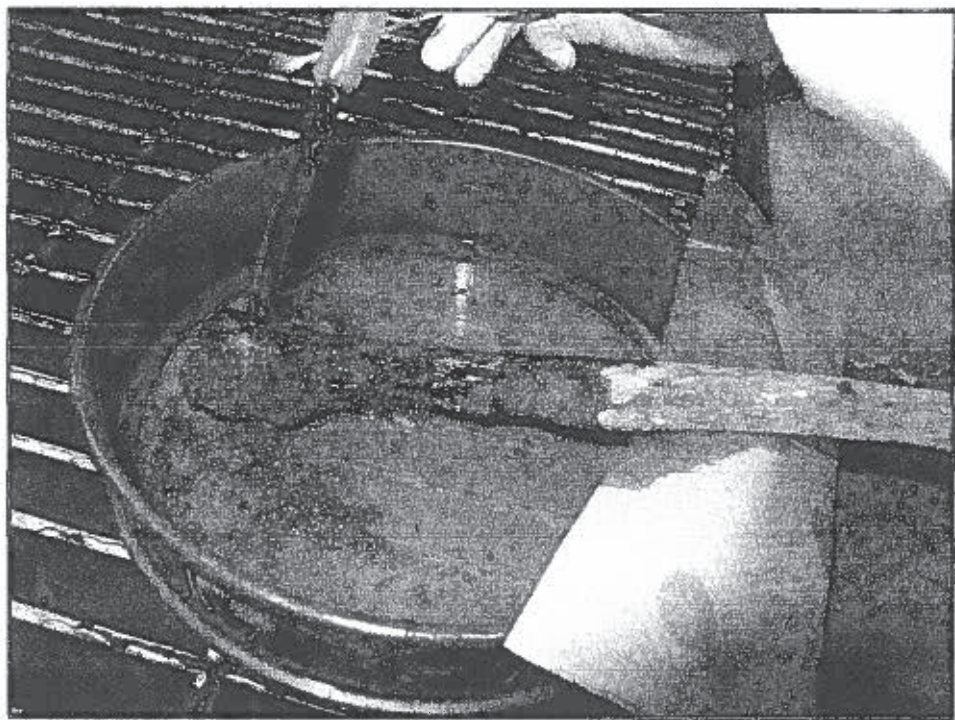


Figure 3.1. Cleaning methodology used when cleaning the long bones over a 250 μ sieve

Each long bone was placed over a 250 μ sieve and gently washed with low-pressure warm water. Extreme care was taken with this process as many of the ends of the long bones proved to be very fragile and a high water pressure would have caused fragments to break off. Occasionally, a soft toothbrush was used on the mid shaft section and cotton buds at the ends to help clean off any sediment and traces of mould. The preservation of the bone was of the utmost

importance and over-wetting the fragile ends would have caused further damage. Therefore it was decided that the damaged ends of the longs bones should be left to dry naturally without being cleaned first. Evidence of the damage to the long bones can be seen in figure 3.2. None of the fragments of bone, such as the iliac crest or right styloid process were glued back into place, although diluted pvc glue was applied to the fragile left pubis *in-site* within the sediment (Dawes & Magilton 1980). After cleaning the bones, they were left to air-dry on tissue over night (figure 3.2).

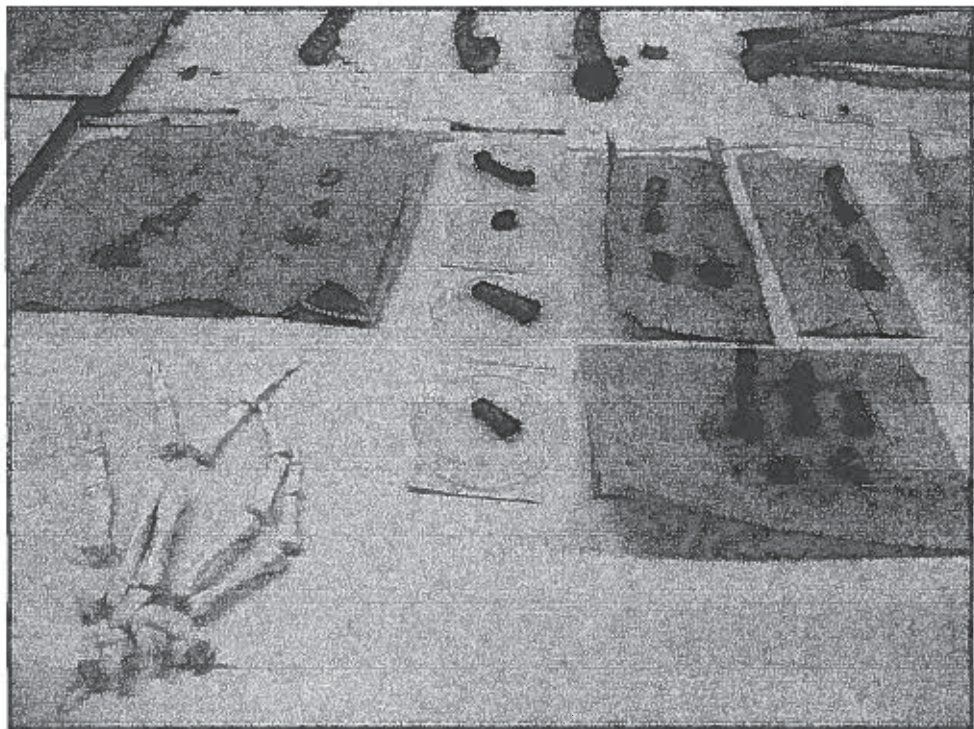


Figure 3.2 The cleaned bones air-drying in the laboratory. The white plastic cast was used to help identify the carpals and metacarpals.

Examination of the bones after 24 hours of drying revealed salt crystals beginning to emerge on the outer bone surface. This is most likely due to the bones starting to dry out after excavation and then becoming wet again through the cleaning process. It was decided to leave the bones to soak for 4 days in distilled water to see if the salt

crystals would dilute out of the bones. The danger of the bones cracking or falling apart from this wet, dry, wet process was foremost in our minds and therefore, only the bones that were considered to be in a good condition and able to withstand this action were treated (Coard 2004 pers comm.). The bones treated were the femora, ulnae, left humerus and left radius. At this time, it was not realised that the right radius had been excavated as it was still situated within one of the larger lumps of sediments, which also contained the pelvis.

By the 4th day both sediment and salt from the bones had diluted into water. A soft toothbrush was used to gently remove the salt cells that remained on the shafts of the long bones whilst keeping them in the water. The bones were left to soak again over night in an attempt to dilute out the large number of salt crystals still present on the bones. It was at this point that we were left with two options on how to continue to treat the bones:

- a) Leave the bones to soak, whilst continually changing the water and removing the salt crystals for as long as it took to remove the salt completely or
- b) Allow the bones to dry thoroughly but not allow them to become wet again

After discussing the options with Dr Coard, it was decided that option (a) could possibly take years to complete and therefore the better option in this case would be to allow the bones to dry out but not allow them to become wet again (Coard 2004 pers comm.). The bones were left to dry for a week before it was decided they were ready to be examined.

3.3. Inventory of Skeletal Remains

Prior to their excavation, a plan had been drawn of the remains in-situ and a pictorial inventory of the bones was completed along with a context sheet – see appendix 1, 2 & 3. However, once the remains had been taken to the laboratory at Lampeter, the first priority was to carry out a second bone inventory.

This second inventory confirmed several important points (Chaplin 1971, Coard 2004 pers comm., Bass 1995).

- 1) There were no duplicated bones suggesting a second individual, was present.
- 2) Enabled exact confirmation of which bones were present.
- 3) Confirmed that all the bones were human.

The remains had been bagged and labelled on site, however a second inventory was advisable and this was completed at the University of Wales Lampeter. The second inventory highlighted that the right ulna had been labelled as the right radius. As the identification of the bones was fundamental to this research this inaccuracy was corrected (Chaplin 1971). As a result, reference manuals such as Bass 1995 and Tortora 2000 were used, as were plastic casts of individual bones in order to correctly identify each bone. In addition, comparisons were made with a complete plastic skeleton from the laboratory. This identification process resulted in both radii being relabelled as ulnae and two further inventories completed, one pictorial and one written.

A summary of these inventories and the bones that have been identified so far are shown in table 2.11.

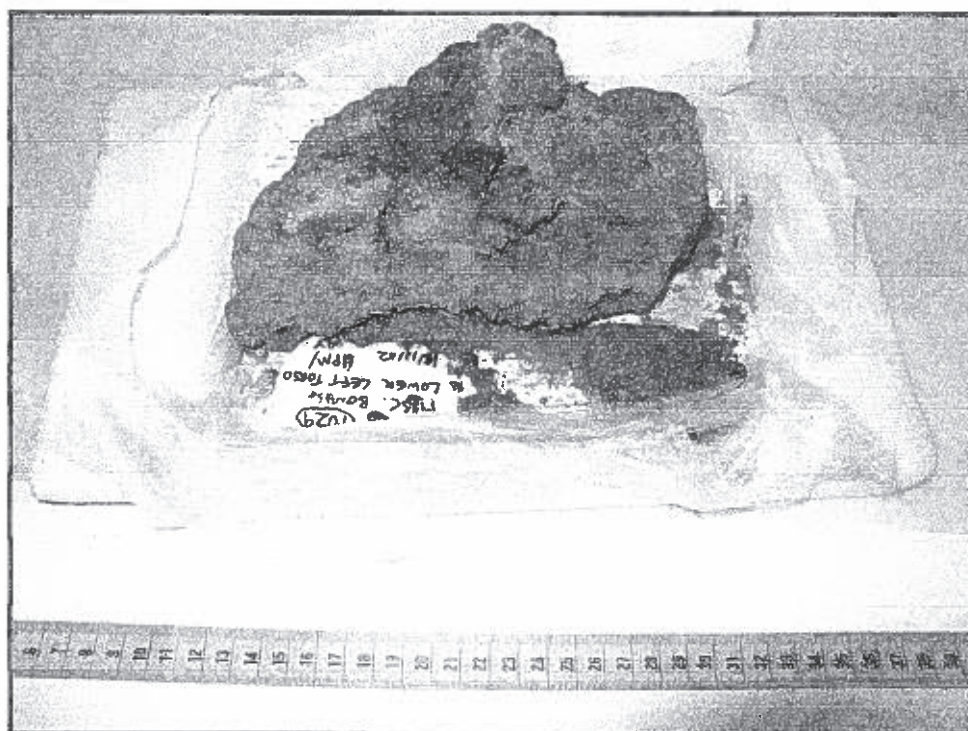


Figure 3.3 Lump of Mercian mudstone sediment with bone inside it

The inventory took time to complete as not only did many of the bones have to be carefully removed from the solid mudstone clay that surrounded them but also many of the bones were in an extremely fragile state (see figure 3.3). It took several days to slowly remove the right innominate from the sediment block and several vertebrae, the sacrum and the left innominate were too fragile to be removed at all. Interestingly, there was no right humerus but the right lower arm and right hand had been preserved, presumably this is because the hand had been lying beneath the pelvis (Coard 2004 pers comm.).

The second inventory confirmed that the following parts had been excavated:

Left humerus
Left and right radius
Left and right ulna
Left and right hand bones
Left and right femur
At least 2 vertebrae
Some ribs
Left and right innominate

The second inventory confirmed that the following parts were missing:

skull
left and right clavicle
right humerus
most of the ribs and vertebrae
left and right fibula
left and right tibia
left and right foot bones.

Therefore, the biological identification of this individual will be inferred from examination and measurements of the following:

Left humerus
Left and right radius
Left and right ulna
Left and right femur
Right innominate

3.3 Bones to be used for biological identity inference

To date, several bones remain in the sediment, such as the left innominate, sacrum, several ribs and some vertebrae as they are too fragile to be removed and therefore absolute correct identification has not been possible.

Below is a description of each long bone and the right innominate that will be used to help determine a biological identity within this dissertation.

Left femur

The left femur had a damp, musty smell to it. There was white mould sitting in striations, highlighting linear striations at the mid point of the shaft. The bone has been handled by Kate Hunter (curator of Newport Museum) who had cleared the mid point shaft with a swab and removed sediment. The shaft appears to be bowed and has been truncated at the distal end resulting in the loss of the epicondyle. The femur had been truncated at the distal shaft resulting in the loss of the epicondyle. The lesser and greater trochanter had been damaged. The head had broken off and lodged into the acetabulum prior to excavation.

Right femur

The right femur had grey mould mainly at distal end with a small amount of mould at the proximal end. The femur does not show signs of being handled or sediment cleared. There is slight cracking on the proximal shaft end with both longitudinal and transverse cracking, which could be due to weathering. The lesser and greater trochanter had been damaged. The head is present but has been detached from the neck. The epicondyle is missing due to the shaft being truncated at the distal end.

Left humerus

The left humerus is relatively mould free and has been cleaned at the distal end, possibly for measuring of bone on site. Although the epicondyle is present the lateral epicondyle has broken off as has the proximal neck and head. The humerus appears bowed rather than straight.

Right humerus

Not present.

Left ulna

The left ulna was recorded as the left radius. It has had the sediment cleaned off along the shaft. The distal end is broken and very fragile and therefore requires careful cleaning. The mid shaft is in good condition but both the semilunar notch and the styloid process are missing.

Right ulna

The right ulna was recorded as the right radius. There was white mould predominately on mid shaft. The semilunar notch was missing but the styloid process is present.

Left Radius

The left radius was broken at the proximal end at the neck. The head is missing. There was no styloid process present.

Right Radius

The right radius was broken at the proximal end at the neck. The head was missing. There was no styloid process present.

Left Innominate

The left innominate was too fragile to be removed from the sediment holding it together. Gently cleaning has revealed a complete obturator foramen, the acetabulum with the femoral head still present and the pubis. In addition, the iliac crest and wing are both visible. The pubis was very fragile and diluted PVA acetone soluble glue has been sprayed on in an attempt to protect this area. There is no pubis symphysis.

Right Innominate

The right innominate was less fragile than the left side but the iliac crest has broken off in several pieces. There was part of the ischium but no pubis or pubis symphysis. The acetabulum was present and so was the greater and lesser sciatic notch. The sacrum articular surface was also present.

3.5 Cutting a Thin Section

A 2" partial thin section was cut from the proximal, anterior shaft of the femur (figure 3.4). The cross section was then cut using a saw microtome to produce 50µm thin slice which was glued on to a plastic slide ready for examination.

Examination of the thin section was carried out following the methodology of Ablqvist & Damsten (1969 cited by Stout 1992) modified from Kerley's (1965) technique. The mounted thin section was placed under polarizing 10x objective microscope with a 1mm² cross grid.

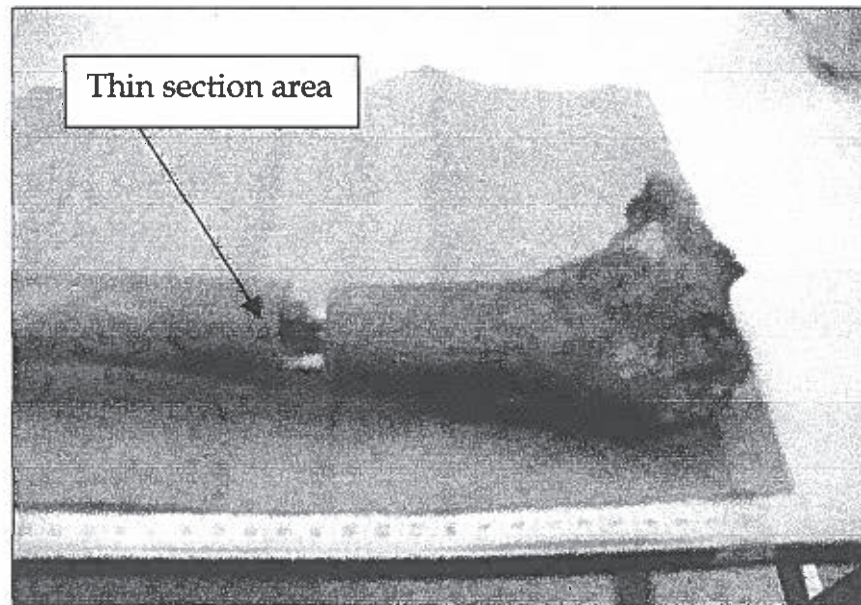


figure 3.4 left femur after the thin section had been removed

The microscopic analysis displayed the osteons, lamellar bone, old osteon fragments and non-Haversian canals and it was the patterning of these four phases that reflected the age of the Newport individual (figure 3. 5) (Stout 1992). Studies have shown that as a person ages the numbers of osteons increase resulting in an older person having more osteons than a young person (Kerley 1965).

Counting of all the osteons and osteon fragments occupied within the square grid was carried out under both natural and polarizing light, as although polarizing light better distinguishes the histomorphological features, it can also show optical osteon fragments that do not actually exist (Stout 1992). As only a partial thin section was taken from the femur, only two circular location fields (rather than the four suggested by Ablqvist & Damsten 1969) were selected from the inner part of the bone. The average number of each phase was calculated and is shown below (Kerley 1965):

The average number of osteons = 14

The average number of fragments of older osteons = 10

The average number of non-Haversian canals and the percentage of circumferential lamellar bone were not calculated.

Although the methodology of Ablqvist & Damsten (1969 cited by Stout 1992) was followed, this procedure was unfamiliar and therefore the examination of the thin section will be revised at a later date possibly resulting in a revised conclusion. The results of the microscopic examination will be discussed in chapter 5.

3.6 Summary

The key issues discussed in this chapter indicate:

- 1 Only the pelvis and long bones were suitable for metric and non-metric analysis to infer a biological identity.
- 2 The thin section indicated the bone was healthy and suitable for microscopic analysis. However this procedure was unfamiliar and would consequently affect the data outcome.

Skeletal Inventory Form (Adult)

Case Number: Newport Theatre Site
 Context Number: 1018
 GGAT Excavation number: 467

CRANIAL SKELETON				
Bone	Side	% complete	Condition	Comments
No cranial bones present				
APPENDICULAR SKELETON				
Clavicle		/		
Scapular		/		
Humerus	L	80	fair	Lateral epicondyle missing, bow shaped, broken from proximal neck
	R	/		
Radius	L	70	Fair	Broken at proximal neck. No head or styloid
	R	70	Fair	Broken at proximal neck. No head or styloid
Ulna	L	75	Fair	No semilunar notch, no styloid process
	R	80	fair	No semilunar notch. Styloid process present
Hands				
Carpals		4 of 16	Fair	
Metacarpals		10 of 10	Fair	
phalanges		18 of 28	poor	
Femur	L	80	Fair	No head. Truncated at distal shaft above epicondyle
	R	80	Fair	Head present but detached. Truncated at distal shaft above epicondyle. Appears bow shaped.
Tibia	L	/		
	R	/		
Fibula	L	/		
	R	/		
Feet		/		
Vertebral column				Unidentified at present
Thorax				Unidentified at present
Sacrum			poor	Too fragile to remove from sediment.
Innominate	L		Poor	Too fragile to remove from sediment. Obturator foramen, acetabulum with femoral head and pubis present. No pubis symphysis present.
	R		Poor	Ilium, part of the ischium, acetabulum and sacrum articular surface present. No pubis, pubis symphysis or iliac crest present.

Table 3.1: All the bones currently identified from the excavation of the human remains from beneath the Newport Ship (form adapted from the one used at University of Wales Lampeter).

Chapter 4

Metric and Non-Metric Analysis

4. Metric Analysis of the long bones

The inference of a biological identity has been based on the examination and measurements of the right pelvis and seven long bones. This chapter will outline the methodology and results produced following measurements taken of the long bones. The pelvis was examined but not measured.

The long bones from which measurements were taken are as follows:

Left and right femur

Left humerus

Left and right radius

Left and right ulna

All the long bones were measured using the recommended methodology taken from Bass (1995). The measuring instruments included sliding callipers, hinge callipers and both cloth and plastic tape. As no osteometric board was available, a cloth tape was fixed to the table and a rigid object placed at each end as a fixing point.

The purpose of obtaining a measurement for each of the bones was to enable a comparison with measurements taken from other archaeological samples collected by various authors. It is now well established that the length and width of long bones can be used to reliably determine stature, sex and race of an individual (Bass 1995). This dissertation will use the measurements produced from the individual and compare these with other published samples. This discussion will follow in chapter 5.

Ideally, the meticulous attention to detail ensures reliable results when measuring each bone, noting exactly which point was measured and the position of the bone (Harrison *et al* 1988). However, no matter how meticulous a person is, human error determines that every measurement will be slightly different. Landmark characterisations on the bone also vary slightly depending on the methodology of the textbook and skeletons measured. Ubelaker (1978) suggests that applying varying standards to data, where biological identity is determined only from the archaeological evidence rather than documentation, incorporates important uncertainties, such as population variation and inaccurate identification (Ubelaker 1978). However, many studies now agree '*it is clear that evaluation of visual criteria is a reliable means of determining sex of skeletal material*' (Molleson & Black 1993: 23). Finally, continual development and modification of scientific measuring techniques has thrown doubt on many of the results of skeletons measured in the past (Bass 1995).

Despite efforts to achieve an internationally recognised anthropometric technique, the ambiguities mentioned above demonstrate that it is very difficult to make comparisons of data from skeletal material measured by different people (Harrison *et al* 1988). In addition, there is still only a small amount of comparative archaeological data available where the biological identity of the individual is already known and recorded, such as the Spitalfields data, where the biological identity of each individual was known before measurements were taken, recorded and analysed. This has enabled a unique, accurate referencing table to be established (Molleson & Cox 1993).

These important points were considered when it came to inferring a biological identity to the skeletal remains based on measurements taken in the laboratory and then compared to archaeological skeletal measurements taken by a variety of other authors.

Once the skeletal measurements were recorded, the measurements were carried out on two other collections of skeletal remains stored at the University of Wales, Lampeter. The first collection, context reference 214, was excavated by GGAT from Cwm Nash, Wales and was radiocarbon dated to 170 ± 60 BP (Sell 1993) and are therefore post-medieval in date. Measurements were only taken from remains where the sex had been established, although the biological identity had been determined from morphological examination rather than from historical texts (Coard 2004 pers comm.). A third set of measurements was taken from a medieval male found at Llanddewi Fach, Wales, context number 394. These measurements were important, as they enabled a comparison of skeletal remains from an unknown date and race found in Wales with Welsh measurements from a known date and location. These, as well as published skeletal data, were then used to infer the sex, age, stature and race of the person, as discussed in chapter 5.

4.1 Femur Measurements

As humans are the only habitual bipeds, the lower limb, comprising of the femur, tibia and fibula has been studied at length concerning its function, anatomy and evolutionary significance. The femur is the largest and the most measured bone of the body and has enabled estimates on age (especially for children), sex, stature and race (Bass 1995, Scheuer & Black 2000). By measuring and comparing the variation and anomalies that are present on the Newport bones to

those recorded from other archaeological specimens certain assumptions and inferences can be made. Certain characteristics on the bone may be due to racial variation or even identify an aspect of the life history of the individual, such as a repetitive habit e.g. squatting. Regular use of certain muscles enlarges those particular muscle attachments on the bone and will most certainly be specific to this individual. Therefore, any variation found on the femora may indicate a habitual, congenital or hereditary characteristic (Pearson & Bell 1919). Figure 4.1 clearly shows the robust features observed on the femora, especially when compared to a modern adult specimen femur. Even with epicondyle broken off the distal shaft and the proximal head detached from the neck, both femora are longer than the specimen. Consequently, the measurements of the Newport femora were important contributions towards the biological inferences within in this dissertation.

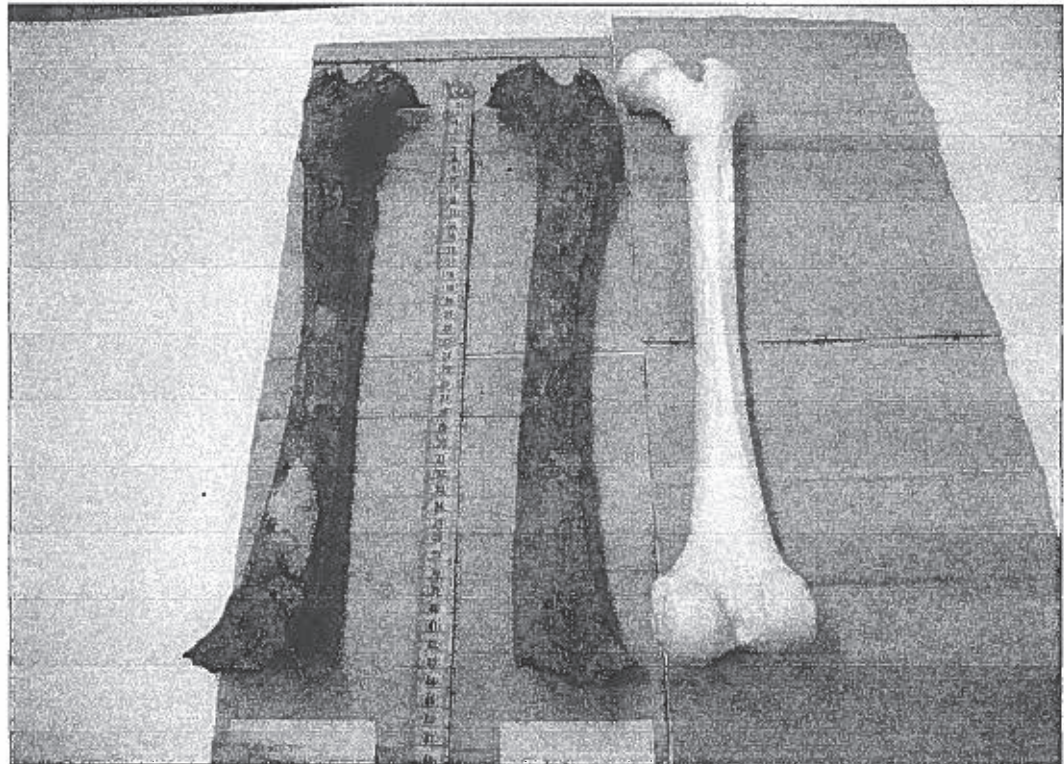


figure 4.1 Left and right Newport femur next to the laboratory plastic specimen. Note the poor condition of both the proximal and distal ends.

Due to both femora being truncated at the distal shaft, resulting in the loss of the epicondyle, plus damage to the greater trochanter and the head around the ossification areas (figure 4.1 & 4.2), inaccurate length measurements and estimates only of the complete length could be recorded. This discrepancy had to be taken into account when the comparisons with other archaeological data were made. However, the right head had separated from the neck shaft and was available for vertical diameter measurement if required. The left head had broken off in the acetabulum prior to excavation and could therefore, not be measured.

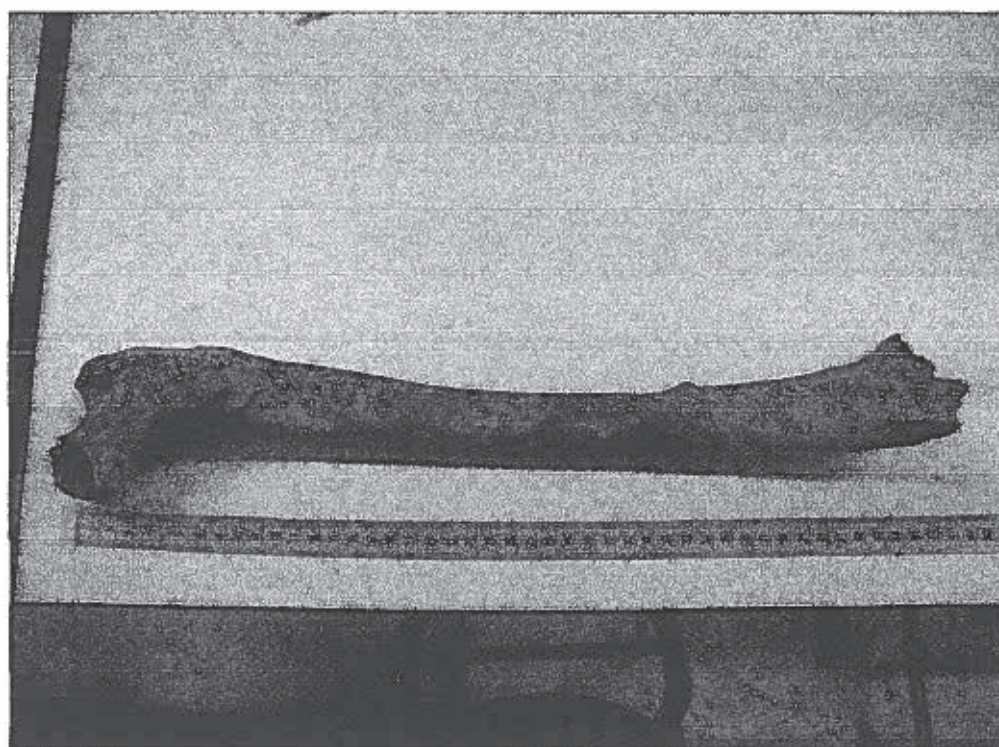


Figure. 4.2 Truncated shaft at the distal end and missing head of the left femur

The landmark measurement points, shown in figure 4.3, show where the measurements were taken from. However, the maximum length (A - B), and bicondylar (oblique) length (C to D) could not be accurately recorded due to the absence of the epicondyle and head (Bass 1995).

the Newport individual and modern European and South American collections in order to predict sex.

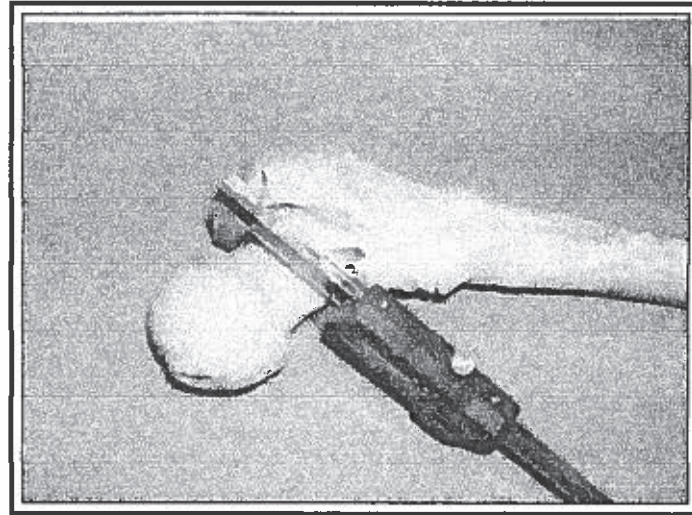


Figure 4.4 Measurement of the SID with a digital calliper (Alunni-Perret *et al* 2003:2)

Alunni-Perret *et al* 2003 measured Caucasian males and females from Nice looking for sexual dimorphism. All measurements were taken using a digital sliding calliper in a supero-inferior direction at the minimum diameter of the femoral neck (see figure 4.4) (Alunni-Perret *et al* 2003).

Measurements were taken from the left and right femora neck and mean SID value calculated. Differences between the left and right femora were minimal (left = 40.76mm and the right = 39.70) and the average SID was calculated at 40.23mm.

Group	Nice	Mexico	Hamann-Todd	Newport
mm				
Caucasian male	35.09	33.91	33.53	40.23
Caucasian female	30.85	28.92	27.86	

Table 4.1 Femoral neck diameter measurements from Caucasian males and females (Alunni-Perret *et al* 2003) and the Newport individual.

Table 4.1 sets out the measurements taken and illustrates that the Newport femoral neck diameters were significantly larger than both the modern European and Mexican male and female samples.

Table 4.2 sets out the measurements taken from the femora using Bass (1995) methodology at the University of Wales, Lampeter.

4.2 Humerus measurements

The humerus is the largest bone in the arm with the proximal head articulating with the scapula and the distal epicondyle with the radius and ulna. The humerus is not usually used to identify the sex of an individual on its own due to high inaccuracy levels. However, these measurements can often be used with other bones for a higher percentage of accuracy such as the femur (Brown unknown date). For the purpose of the biological identity, only the left humerus was available for measurement. Examination indicated that all of the eight ossification areas along the humerus had fused prior to death (Bass 1995, Brown unknown date) and the distal humeri displayed a shallow septal aperture foramen just above the trochlea, usually hollow in females (Bass 1995).

Studies of the humerus have revealed a relationship to the life history of the individual and the muscle markers found along the bone. The distinct markings and projections that form where tendons, ligaments and muscles attach to the underlying bony cortex are evident on the skeleton and are indicative of regular, repetitive use of those muscles (Weiss 2003). In most skeletal remains males usually have the larger muscle attachments and more robust bones (Weiss 2003). Studies have also shown that muscle attachments enlarge with age, which may support the suggestion that the remains

were from a mature person (Chamberlain 2004 pers comm.). Examination of the left humerus revealed enlarged muscle attachments and robust features such as a wide epicondylar, even with the lateral epicondyle missing.

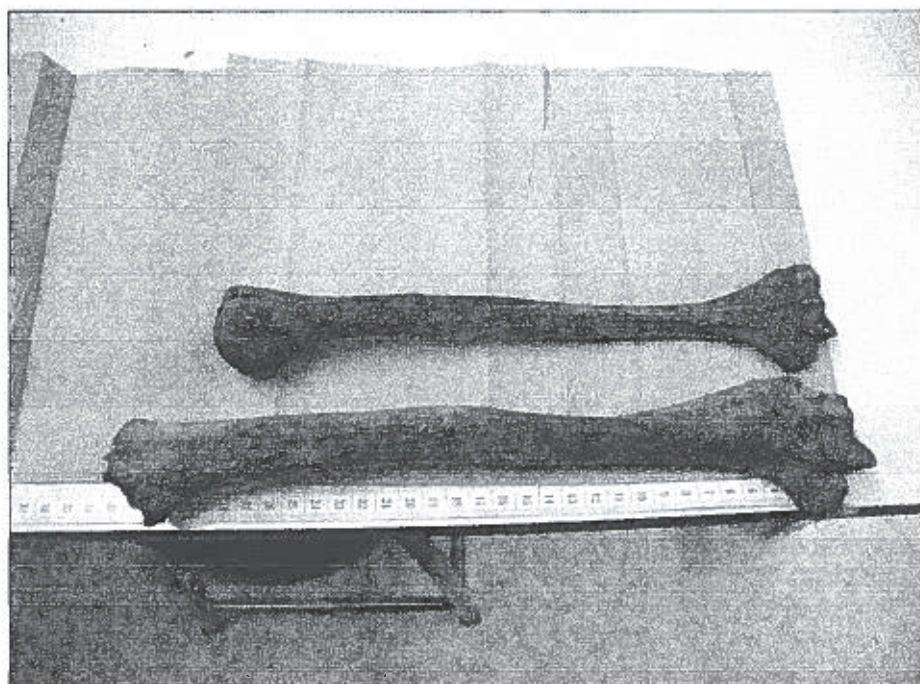


figure. 4.5 Comparison of the Newport left humerus (bottom) to a sample adult humerus (top). Note the robust, bowing mid shaft and wide epicondyle and broken proximal neck.

Figure 4.5 demonstrates these features on the Newport humerus lying next to a sample adult humerus from the University collection. Prior to being measured, the morphology of the humerus showed it was longer and wider than the sample skeletal humeri. Bowing to the mid-shaft was also noticed and may be indicative of specific habitual patterning such as rowing or lifting (Junno 2004).

The landmark measurement points, shown in figure 4.6, show where the measurements were taken from. However, the bicondylar width could not be accurately recorded due to the absence of the lateral

epicondyle. In addition the maximum length could not be measured (A - B) as the head was missing. Instead, measurements were centred on the mid-shaft (Bass 1995).

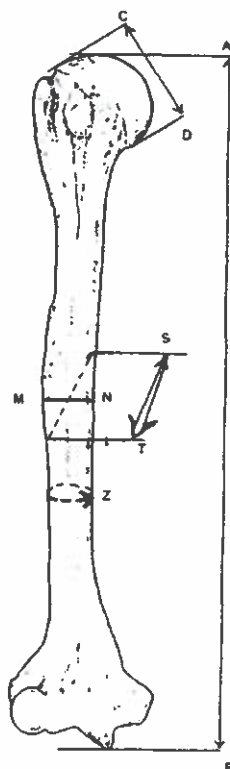


figure 4.6

Landmarks for measuring the humerus (Bass 1995: 153).

Table 4.3 sets out the measurements taken from the left humerus using Bass (1995) methodology. The measurements of the humeri taken from the Cwm Nash (214) collections are also recorded. There was no humerus available for measuring from the Llanddewi Fach (394) collection.

4.3. Radius Measurements

The radius is the shorter of the two bones in the lower arm. It is positioned laterally and is medial to the ulna. The radius articulates proximally with the humerus and distally with the scaphoid and lunate carpus at the wrist (Bass 1995, Scheuer & Black 2000). Although epiphyseal fusion of the head on to the neck occurred when the individual was around 14 – 15 years old and the distal styloid process union at 18 – 19 years old, both the head and styloid process were broken off leaving behind the mid-shaft. This meant it was difficult to use the radii for the metric analysis of biological identity (Brown unknown date). Occasionally, there can be congenital defects related to the development of the radius, which severely restricts the movement of the arm, and even cause an absence of the bone altogether (Scheuer & Black 2000). There did not appear to be any congenital abnormalities on the radii.

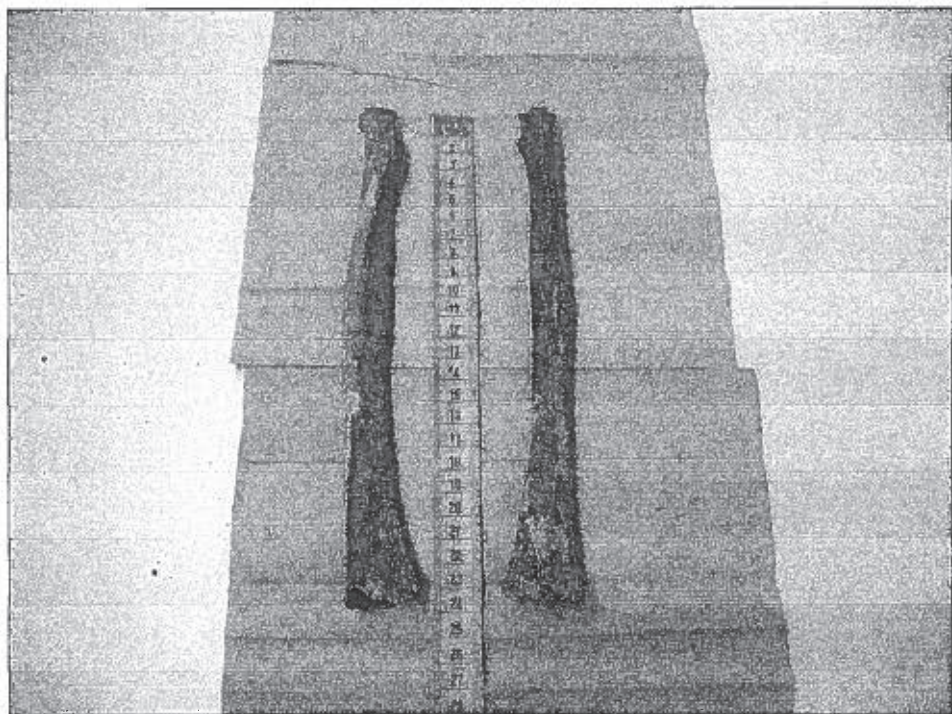


figure 4.7 Left and right radii. Note the damage to the proximal and distal ends, and bowing to the right radius.

Steele (1972) has published a sex determination formula using the radius and Garn et al (1966 cited Brown unknown date) have shown ossification patterns are different between males and females. Studies have also shown that female ossification occurs earlier in males, resulting in the midshaft being shorter in the females (Bass 1995, Brown unknown date). Consequently, the measurements of the radii were not used to estimate the stature, sex or race. As both the femur and humerus were present, a more accurate estimate could be provided.

It has been established right-handed adults have greater muscle mass in the principal arm and the right radius tends to be longer than the left side (Steele 2000). This was difficult to estimate in the Newport radii due to the damage at both ends, however, observation of the two lying side-by-side indicated the right radius had a broader midshaft with distinct bowing (figure 4.7).

The landmark measurement points in Bass (1995) indicate only the maximum length is usually taken. However, even these figures were inaccurate due to the damage on both radii and therefore it was not possible to calculate a comparison using the humeroradial index (Bass 1995).

Table 4.4 sets out the measurements taken from the radii using Bass (1995) methodology. The measurements of the radii taken from the Cwm Nash (214) collections are also recorded but there were no radii from the Llanddewi Fach (394) collection.

4.4. Ulna Measurements

The ulna is the longer of the two bones in the lower arm and is positioned on the medial side, parallel with the radius. The ulna articulates distally with the radial notch and head and proximally with the humerus (Bass 1995).

Figure 4.8 shows the damage to the left ulna proximal coronoid process, and the olecranon and distal styloid process had broken away. Therefore, even though epiphyseal fusion of the proximal ulna would have occurred around the age of 14 years old and distally at around 18 - 19 years old, evidence for this fusion was missing (Brown unknown date). The right ulna was more complete as the styloid process was still attached. Although there was damage to the coronoid process, this was not as bad as the left ulna and the physiological length could be measured.

Some studies have shown preferential development of the supinator crest due to one arm being used more than the other in an over-arm throwing action, possibly reflecting stress on the muscles caused by spear hunting (Kennedy 1983 cited Steele 2000: 311). However, overall, the ulna displays the least amount of stress caused by mechanical load on the arm (Steele 2000). The ulna also holds very little significance within anthropological research (Brown unknown date).

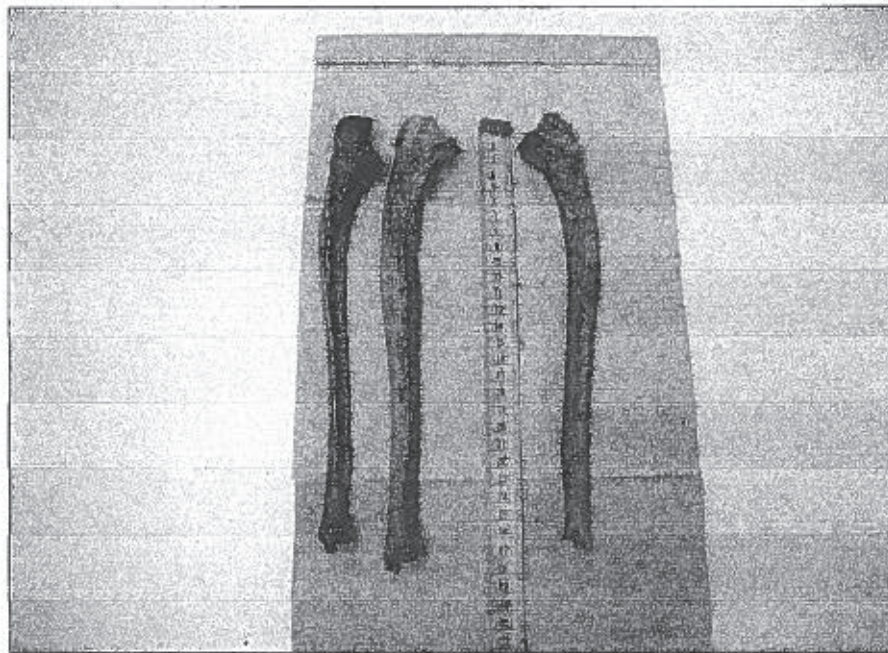


Figure 4.8 Left and right ulna with an adult sample ulna on the far right. Note the damage to both the distal and proximal end of the left ulna, but complete styloid process to the right ulna.

The landmark measurement points in Bass (1995) enable measurements to be taken of the right physiological length and the mid-shaft least circumference. However, the maximum length could not be taken on either ulna as both had damage to the olecranon and coronoid process.

Table 4.5 sets out the measurements taken from the ulnae using Bass (1995) methodology. The measurements of the ulnae taken from the Cwm Nash (214) collections are also recorded but there were no ulnae available from the Llanddewi Fach (394) collection.

4.5 Non-Metric Analysis of the Innominate

The left and right innominate bones form the pelvic girdle through articulation with the midline sacrum and coccyx (Scheuer & Black 2000). Studies have confirmed that the pelvis is the best area of the

skeleton for determining the sex of an individual and therefore the presence of both the Newport individual's innominate bones enabled an accurate sex determination of the individual. Complete fusion rates can vary greatly but are usually complete by the age of 24 years, with the iliac crest and ischial tuberosity being the last to unite, and this fusion could be seen on the innominates (Bass 1995). Only the right innominate was stable enough to be removed from the sediment, although damage had occurred around many of the more fragile ossification areas. Although the left innominate (see figure 4.9) was too fragile to be removed from the sediment, the obturator foramen, acetabulum and pubis could be seen.

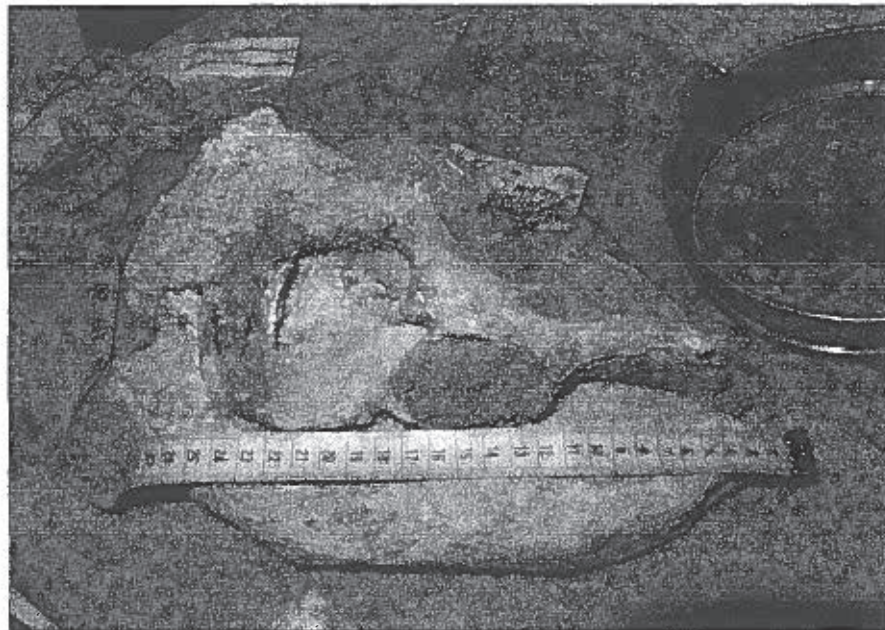


figure 4.9 left innominate – too fragile to be removed from the sediment but allowing observation of the obturator foramen, acetabulum with femoral head broken in it and pubis.

Once cleaned, the right innominate appeared sturdy around the ilium, acetabulum, the ischium and posterior superior iliac spine. The greater sciatic notch was present and so was the ischial spine. However, as figure 4.10 shows, many of the more fragile areas, usually around the fusion points, were damaged. The iliac crest had detached and the pubis had broken away.

- 2) Where possible, comparison of data should be made with skeletal remains from a known source where biological identity is known.
- 3) Despite the poor condition of parts of the bones, measurements and examination provided enough information to infer parts of the individual's biological identity.

Table 4.2 Femur measurement results

Specimen name	Max length	Trochanteric oblique length	Vertical diameter Head	mid-shaft circumference	mid-shaft mediolateral max diameter	mid-shaft Anterior/posterior max diameter
	mm	mm	mm	mm	mm	mm
Measurement points fig 4.2	A - B	C - D	E - F	M - N	M - N	S - T
Newport Left	437 *	444 *	n/a	108	32.35	29.68
Newport Right	455 *	438 *	52.66	105	32.69	29.35
214/ 009 Left	447	426	47.34	91	31.73	26.82
214/ 012 Right	446	435	46.56	97	28.26	28.25
214/ 013 Left	437	419	48.90	98	32.51	30.18
214/ 013 Right	437	407	49.77	97	32.27	28.86
MP 41 Left	468	459	45.43	91	28.56	27.79
394/011 Left	499	478	56.85	105	34.44	30.27

Measurements taken from samples available at University of Wales, Lampeter.

214 = Cwm Nash - Post Medieval Welsh

394 = Llanddewi Fach - Medieval

MP = Magor Pill - Medieval

* = incomplete measurement due to absence of epicondyle on Newport femora.

Table 4.3 Humerus measurement results

Specimen name	Max length	Mid-shaft max diameter anteromedial	Mid-shaft max diameter Anterior/posterior	Mid-shaft least circumference	Deltoid tuberosity	Bicondylar max width
	mm	mm	mm	mm	mm	mm
Measurement points fig. 4.3		M - N	S - T	Z		
Newport Left	315	20.99	23.98	72	89	*
214/009 left	.n/a	19.20	19.20	65	73	62.42
214/012 left	.n/a	20.74	21.82	62	76	60.26
214/013	.n/a	n/a	n/a	n/a	n/a	n/a
394/011	.n/a	n/a	n/a	n/a	n/a	n/a

Measurements taken from samples available at University of Wales, Lampeter.

214 = Cwm Nash - Post Medieval

394 = Llanddewi Fach - Medieval

- = incomplete measurement due to absence of the lateral epicondyle. n/a = bone not available for measurement

Table 4.4 Radius measurement results

Specimen name	Max length	
	mm	
Newport left	235* +	
Newport right	n/a	
214/011 right	227 +	
214/012 left	237 +	
214/013 left	225	
214/014 right	232	
394/011	n/a	

Measurements taken from samples available at University of Wales, Lampeter.

214 = Cwm Nash - Post Medieval

+ = missing styloid process * = broken head n/a = bone not available for measurement

Table 4.5 Ulna measurement results

Specimen name	Max length	Physiological length	mid-shaft least circumference
	mm	mm	mm
Measurement points from fig. 4.?????	C - D	A - B	E
Newport left	264 * +	248 *	45
Newport right	279 +	266	44
214/009 right	241 *	217*	36
214/011 right	253 *	227 *	43
214/012 left	269	235	34
214/103 left	244	220	35
394/011	n/a	n/a	n/a

Measurements taken from samples available at University of Wales, Lampeter.

214 = Cwm Nash - Post Medieval

394 = Llanddewi Fach - Medieval

+ = missing styloid process * = broken olecranon n/a = bone not available for measurement

Chapter 5

Inferring a biological identity

5. Inferring a biological identity

'Each skeleton tells a unique and highly individualistic story about the life of the person it represents' (Larsen 2000: 3).

As discussed in chapter 4 metric measurements were taken from both the Newport remains and a small number of Welsh specimens stored at the University of Wales, Lampeter. A lack of published material from Welsh prehistoric and modern specimens was aided by the availability of these skeletal remains dating between the medieval period through to the 17th century AD. These sites included Cwm Nash, Llanddewi Fach and Magor Pill. The data extracted from these samples was then compared with records of published measurements observed from a variety of locations and dates. The key question was: could the metric and non-metric observations discussed in chapter 4 lead to an inference on the biological identity including the sex, age, stature and race of the individual?

The comparable material was taken from a range of samples from known date, race and biological identity and is shown in table 5.1.

It was considered important not to make any assumptions about the individual's identity before looking at the metric and non-metric observations, as the visual interpretation may have been misleading. For example; the stratigraphy of the river Usk was found to be unreliable for dating purposes and therefore, it could not automatically be assumed that the individual dated to the medieval period purely because it was lying beneath a medieval ship. Likewise, it could not be assumed that this was a young individual

just because there had been damage to the ossification areas on the long bones.

Location/site	Period	Race	Author
London	Modern (17 th century)	English	Pearson 1919 Table IV & V
Spitalfields, London	Modern (19 th century)	English	Molleson & Cox 1993
Nice	Modern (20 th century)	Italian	Alunni-Perret <i>et al</i> 2003
Cwm Nash	Modern (17 th Century)	Welsh	Uof W Lampeter
Llanddewi Fach	Medieval	Welsh	Uof W Lampeter
Mexico	Modern		Alunni-Perret <i>et al</i> 2003
Ohio	Prehistoric	American	Black 1978
York	Medieval	British	Dawes & Magilton 1980
Anatolian	Chalcolithic 3000 BC	Turkish	Ziylan & Murshid 2002
/	Neanderthal	French	Pearson 1919 Table IV & V
California	Pre-historic	American	Dittrick & Suchey 1979

Table 5.1 Sites and dates that produced the comparable measurement data

Therefore, through the process of this analysis on the bones, a biological identity could be inferred and only then could a broader cultural identity be looked at. For example, if it could be inferred that the person was Portuguese, implications concerning the individual's relationship with the ship, trade route and cultural exchange of people could be examined.

All skeletons display characteristics of their own specific lifestyle variations (Mays 1998). Therefore, observations were made on both skeletal growth and the lifestyle variation characteristics such as signs of physical signs of stress, diet, occupation and disease (Larsen 2000). The results of the examination were able to provide a wealth

of information relating, not only to the individuals' sex, age, stature and race, but also to enable inferences on the physical activities and lifestyle the individual may have been exposed to (Larsen 2000).

5.1. Establishing Sex of the Individual

Although the whole skeleton should be taken into account when determining the sex, the pelvis and skull that are the most sexually dimorphic areas of the body and it is the pelvis that enables the highest degree of accuracy when sexing skeletal remains (Bass 1995, (Mays 1998), Ubelaker 1978). Observations for sexing the individual were carried out on the pelvis and femur, as the skull had not been located during the excavation. Differences in the skeletal growth between males and females are not easily distinguished until a second marked phase of bone growth, during early adolescence, enables the cortical bone to grow at a greater rate in males (Black 1978). However, this observation is only possible if these remains are present for sexing within the archaeological context (Black 1978, Ubelaker 1978).

The highly divergent function of the pelvis between males and females explains the characteristic sexual differences. Due to the evolution of bipedalism in humans, males have developed a large but narrow pelvis, which is robust and muscle marked, and therefore more efficient for locomotion. The female pelvis, however, has become broader but shorter, and is shaped to form the birthing canal. By the time a person has reached the age of 18, sexual dimorphism of the pelvis is quite distinctive (May 1998, Ubelaker 1978).

The significant differences between the male and female pelvis include a wide, u shaped sub-pubic angle at the front of the pelvis and a less curved sacrum at the back in females and a larger, more

robust pelvis with a narrow sciatic notch, V shaped sub-pubic angle and more curved sacrum at the rear in males (Mays 1998). Other differences are also seen in the innominate, such as the articulation of the sacro-iliac or the presence or absence of the ventral arch (Bass 1995). Questions were then raised on what differences could be seen in the Newport innominates and had enough of the pelvis survived to allow sex determination?

The methodology used for the examination of the pelvis was primarily taken from Bass (1995). Some parts of the Newport left and right innominates were too fragile and incomplete to examine in detail. Although the left side was too delicate to be removed from the sediment the obturator foramen, the acetabulum with the femoral head broken off in it, the auricular surface and the pubis were visible. The right innominate was missing the pubis, pubis symphysis and iliac crest but overall was less fragile and more complete than the left side.

Figures 5.1 and 5.2 identify the visible differences between the adult male and female pelvic girdle (Mays 1998). The arrows (labelled A - D figures 5.1 & 5.2) indicate four of the observable characteristics that were found on the Newport innominates and these included:

A = a highly muscle marked and rugged ilium

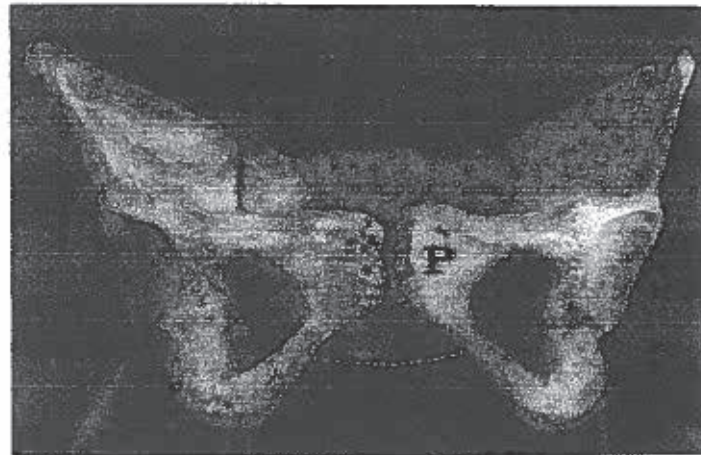
B = a small but deep sciatic notch

C = a large acetabulum

D = a large, ovoid obturator foramen



above: male adult pelvis with arrows showing the observations made on the Newport innominates



above: female adult pelvis

figure 5.1 above Difference between adult male and female pelvic girdle (Mays 1998: 34).
Figure 5.2 below: the arrows highlight the characteristics present on the Newport right innominate

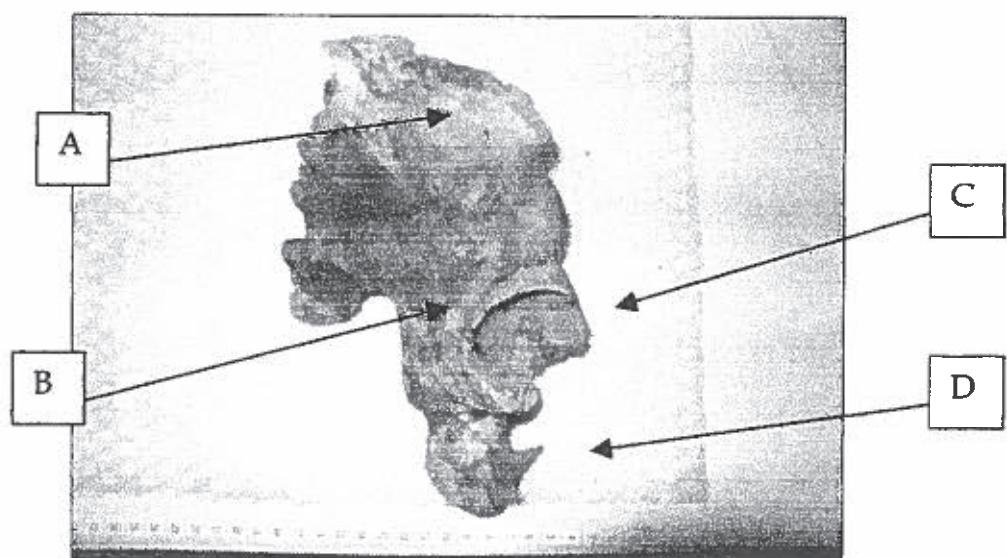


Table 5.2 lists the features present in the Newport innominates used to determine the sex of the individual (taken from Bass 1995: 216).

Feature present	Newport Male	present	Female	present
Shape of pubic bone	Narrow	√	Broad and rectangular	X
Ventral arch	absent	n/a	present	n/a
Sciatic notch	Small, deep	√	Wide, shallow	X
Auricular surface height	Not raised	√	Raised	X
Ilium shape	High, vertical	√	Laterally divergent	X
Acetabulum size	Large	√	Small	X
Obturator foramen	Large, ovoid	√	Small, triangular	X
Developed muscle markings	Marked, rugged	√	Gracile, smooth	X

Table 5.2 Features identified and used to determine the sex of the individual.

Table 5.2 shows there were a minimum of seven characteristics suggesting the pelvis belonged to a male individual, although not all the characteristics listed by Bass (1995) were observed, either due to the fragmentary nature of the bone or because these areas were absent.

Studies have shown a higher accuracy rate of sexing can be achieved by identifying at least three characteristics rather than a complete list of individual criteria, e.g. the obturator foramen shape and presence of the ventral arc = 98%, whereas one characteristic has a reduced accuracy rate, e.g. muscle markings = 56.8%. Few fragile bones survive in the archaeological record and this identification criterion

has been successfully used on many specimens (Bass 1995, Dawes & Magilton 1980, Roger & Saunders 1994 cited Bass 1995:216).

As the morphologic examination of the pelvis identified at least seven male characteristics, (table 5.2), it was therefore possible to infer the sex of the individual as male (Mays 1998). However, confirmation of the sex identification did not rely on the observation of the pelvis alone (Bass 1995).

Measurements of racial and sex differences in the post-cranial skeleton of various populations often result in confusion over whether the individual is a small male of one race (e.g. Asian) or a large female of another race (e.g. European) (Coard 2004 pers comm.), due to overlapping sizes. Therefore, one of the main questions was: did the size of the Newport femoral measurements fall into a definite male category of any race or were the remains from a large female of a particular race? and was there confidence that this was one individual or was it an assemblage of many people, that may bias the measurement data?

As it was almost certain that the remains belonged to only one individual (chapter 1 & 3), the measurements of the femora were studied in order to answer these questions and support the findings from the pelvic data.

Typically the femur displays strong sexual variation, as morphological differences develop due to differential hormone release in males during early childhood growth (Mays & Cox 2000). Although sexual differences can be less consistent in the long bones, generally male bones are longer and larger than females (Bass 1995, Ubelaker 1978). Comparison of data from various populations is now possible and this procedure was carried out between the Newport femora measurements and both sexes of various races. One set of data came

from the Spitalfields project, which uniquely produced a set of comparable measurements from skeletons of known race and sex (Molleson & Cox 1993).

Although generally sexing has been based on well-preserved skeletons, published material that also included measurements of the mid-shaft circumference and midshaft anterior/posterior diameter were used. This method of measuring was useful as both Newport femora had been truncated above the distal epicondyle, and both proximal heads had become detached. This method compares well with other more complicated means of sexing, especially femoral length (Black 1978, Spruiell 1984 cited Bass 1995:231, Bass 1995). However, care must be taken when comparing characteristics on bones from sexes of different races, as congenital and hereditary differences may often occur (Pearson & Bell 1919, Black 1978).

Table 5.3 (page 85) lists a range of comparable measurements recorded from various archaeological sites and these measurements appear to confirm the results of the pelvic examinations. The comparisons of the femora measurements indicate that the Newport midshaft circumference falls outside the range of all the female samples. Although the Newport femora length was incomplete it was still longer than all the complete female femora. This patterning can also be seen on the midshaft anterior-posterior diameter, where the Newport measurement is larger than all the female measurements but within the range of the males.

It has been argued that a higher accuracy rate (90%) can be achieved from the measurements of femoral head diameter or bicondylar width (Dittrick & Suchey 1986). In the case of the Newport individual, all femoral heads and epicondyle were missing and therefore, only the midshaft dimensions were suitable for comparison. Another method of assessing sex from the femur is from the measurement of the supero-

inferior femoral neck diameter (Alunni-Perret *et al* 2003). This data (shown in table 5.3) confirms that the Newport supero-inferior femoral neck diameter was significantly larger than both the modern European and Mexican male and female samples.

In conclusion, the visible observations of the pelvis identified seven male traits with no female indicators. This observation was supported by the metric measurements of the femora when compared to a variety of male and female samples. Therefore, it can be confidently proposed that the Newport individual was a single individual and male.

5.2 Age at death

'What biological changes occur in the skeleton during life that allow us to estimate the age at death with a reasonable degree of accuracy?' (Bass 1995: 12)

Estimating the age at death of the individual can be assessed from the morphology of the skeleton in a number of ways, mainly observations on the chronology of the teeth, ossification rates of the bones and the wear and tear on the skeleton sustained through life (Ubelaker 1978). In addition, microscopic techniques are now producing good estimates of age, especially from fragmented bone. By the time an individual has reached 20 years old, most of the teeth have erupted, growth of the bones is almost complete and the epiphyses have fused (Ubelaker 1978). Much research on age at death has centred on the growth rate and wear of teeth. However, this was not possible on the Newport remains and therefore, the estimation was based on macroscopic and microscopic examination of the femur and pelvis.

The morphology of the long bones and pelvis acknowledged that the skeletal size of the individual would have fallen into the range of a modern adult today. It has been recognised that the rates of ageing and degeneration within the skeleton can vary between populations and through time, but little data has been generated recording such changes (Mays 1998, Bass 1995). Even within populations, individuals mature and grow at different rates (Bass 1995). Therefore, extreme care was taken during the examination of the femur and pelvis in order to determine as accurate an age as possible for the individual.

Extensive damage had been noted at many of the ossification areas and this raised the suggestion that the individual may have been aged between 14 years and 25 years, as the sequence of fusion provides a good estimate of age (Mays 1998, Singh & Gunberg 1970). Therefore, did the damage to the ossification areas indicate that this was a young adult or would the microscopic and macroscopic analysis reveal an older age?

In chapter one it had already been established that much of the damage to the bone ends had been caused by decay from the fluvial environment. Therefore, if it was assumed that ossification had already taken place and the measurements of the bones fell into the modern adult range, it could be implied that the skeleton had completed the ossification process.

Once the bones had stopped growing and ossification was complete, it was the examination of other changes within the skeleton that were used to estimate age at death. Mays (1998: 51) indicates there are at least nine features (figure 5.3) that can be used to estimate the individual's age including:

1. cranial suture closure
2. rib end morphology
3. auricular surface morphology
4. pubic symphyseal morphology
5. bone microstructure
6. loss of trabecular bone
7. tooth wear
8. cementum incremental layers
9. dental microstructure

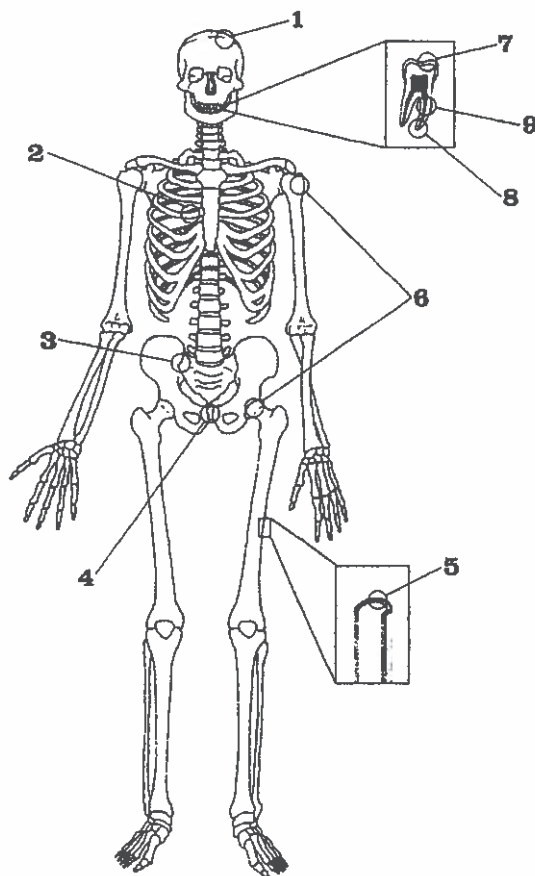


figure. 5.3 Observations on the skeleton used infer an estimate of the age at death (Mays 1998: 51)

As only the long bones and pelvis were used for estimating the biological identity, it was only possible to look at feature 3, (the auricular surface morphology) and 5, (bone microstructure). Close examination of the auricular surface on the pelvis revealed horizontal striations across the surface, indicating wear and tear, with no billowing present. The ilium was very robust suggesting large muscle attachments usually found on an older adult rather than a teenager (Chamberlain 2004 pers comm. Junno 2004 pers comm.). This suggested that the individual was actually closer to 30 years than 20 years. It was unfortunate that the pubic symphysis did not survive, as this part of the pelvis would have been particularly useful for estimating the age of this person. The standard deterioration of the pubis symphysis could have been compared to benchmark indicators produced by Todd (1920 cited Thomas 1995).

Research has shown that a histologic study of the thin section from the femur might prove useful in determine the age at death of the individual (Singh & Gunberg 1970). Microscopic changes in the bone structure occur with age and these changes can be quantified (Kerley (1965). This methodology is discussed in chapter 3. Many formulae have been published in order to calculate the age at death from these quantified histological studies. However, many of these formulae appear skewed and biased towards the samples studied by the author, rendering the estimated ages either too high or too low (Stout 1992, Aiello & Molleson 1993, Uytterschaut 1985). These obstacles were coupled with a probably inaccuracy of Newport osteons and osteon fragment count due to being unfamiliar with the process. Consequently, the ages at death calculated from the formulae are cautiously estimated and require reconsideration at a later date inevitably generating a revised age range.

Three equations were chosen to estimate the age at death of the individual.

The first was the regression equation taken from Singh & Gunberg (1970:377 table 4).

Their estimated age at death = 51.7 ± 3.60 years

The second equation was taken from Bouvier & Ubelaker (1977:392) based on Kerley's (1965) regression equation.

Their estimated age of death = 41.7 ± 9.39 years

The third equation was taken from Aiello & Molleson (1993:693) based on Kerley and Ubelaker (1978).

Their estimated age of death = 26.05 ± 11 years

A photograph of the Newport microscopic slide was then compared to microscopic slides from a 17 year old male, a 40 year old male and a 57 year old male (Jowsey 1960) (figures 5.5, 5.6 & 5.7). Figure 5.4 illustrates the slide from the Newport male femur, which has a number of complete osteons and lamella bone. There did not appear to be any low mineral density seen on the 40 year old, but there was no original lamellar bone left either, seen on the 17 year old (Chamberlain 1994). It may be suggested therefore, from the observations of the microscopic slides that this individual's age range falls within 17 and 40 years old.

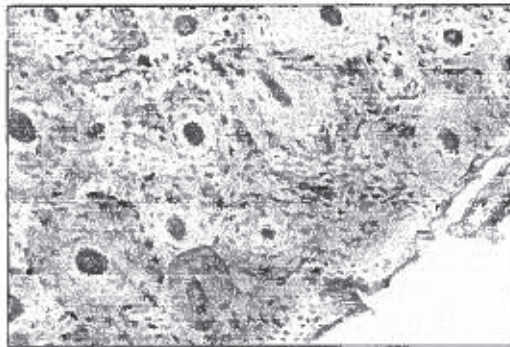


Figure 5.4
Newport male of unknown age.

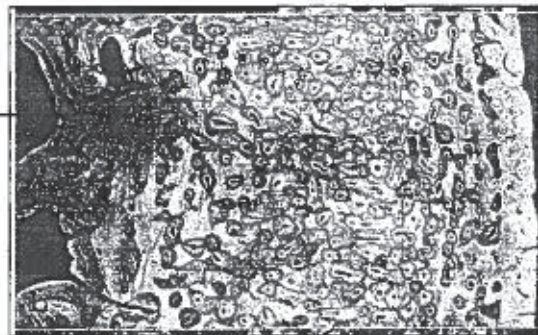


Figure 5.5
17 year old male

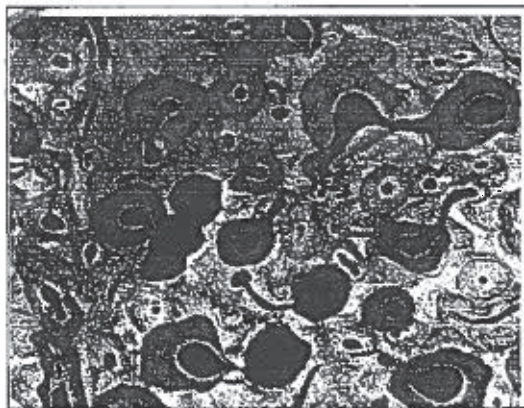


Figure 5.6
40 year old male

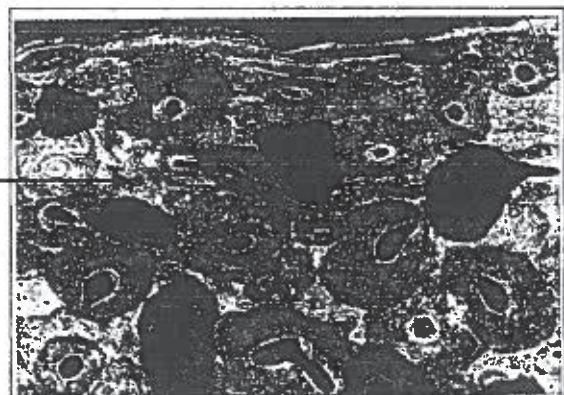


Figure 5.7
57 year old male

Comparison of microscopic slides from the range of age groups inferred from macroscopic and microscopic observations of the Newport pelvis and femur

In conclusion, it would appear that no two methods of assessing age at death were able to produce an accurate age of the Newport individual. A close correlation appeared between the macroscopic analysis of the pelvis and comparisons of the slide, but even these were inconclusive. Therefore it can only be inferred that the individual was older than 20 years old and younger than 51 years. Further research is required on this area, outside the scope of this dissertation.

5.3 Estimating living stature

Studies of growth rates in modern populations from different social backgrounds have highlighted the effects famine, warfare and stress can have on the skeletal development. Research has shown a relationship between social environments to which a population is exposed and the corresponding skeletal health and growth rates (Humphrey 2000). Although analysis of the skeletal growth will not directly indicate the cause of any developmental stress, interpretation of the data within a wider context may enable inference to be made about the individual, his contemporaries and their habitat.

It was with the development of the mathematical regression equation in the 1890's that Totter and Gleser (1952 cited Bass 1995:26) have been able to produce the most reliable and widely used tables of stature estimates. Research has since shown that estimates of stature are problematical due to racial differences and variations of height through time. Studies on pre-mortem measurements have

highlighted at least four discrepancies when estimating the stature of living people that could then be used as data post-mortem. The comparison of data between archaeological specimens from long bone measurements and living populations today have been known to highlight cause many inconsistencies (Bass 1995).

Due to the problematic nature of calculating the living stature of an archaeological specimen, there has been a general lack of agreement and standardisation of measurements. This has made it difficult to assess the living stature accurately (Coard 2005 pers comm.). Numerous formulae have been published based on varying methods of calculations. For example;

Dwight (1956 cited Bass 1995:32) suggests measuring all the long bones plus a soft tissue correction; Pineau (1960 cited Ubelaker 1978:60) suggests measuring femur, 5 vertebrae plus correction, Genovés (1967 cited Bass 1995:33) suggests measuring more than one complete long bone and Trotter & Gleser (1952 cited Bass 1995:233) recommend not using upper long bones alone.

This array of methods is confusing but more importantly, where does this leave this isolated and incomplete archaeological specimen as most formulae assume complete and intact skeletons?

It was decided to adopt the methodology published by Trotter and Gleser (1952 cited Bass 1995:233) as it better fits the data set criteria. This estimation of stature was further complicated due to the incomplete femora. For the purpose of this dissertation, the right femoral head was fixed back on to the neck and the epicondyle of a European male femur of a similar size was measured and added to the length of the Newport femur (Chamberlain 2004 pers comm.).

The measurements of the femur were taken as follows:-

Newport right femur:

Length from proximal head to distal truncated

epiphyses = 45cm (450mm)

European male femur:

Length from proximal epicondyle to distal

medial condyle = 2.7cm (27mm)

Overall estimated length =

45cm + 2.7cm = 47.7cm (477mm)

This estimated maximum length enabled the individual's height to be inferred from a variety of published tables. Here too, the stature of the individual would be influenced by racial and genetic differences. Consequently a range of data from various locations was required to estimate his living stature (Ubelaker 1978). Table 5.3 reproduces the formulae published by Totter & Gleser (1952 cited Bass 1995:233) that were used to calculate the stature.

Stature formulae for the femur - male		
race	mean	range
White	$2.32 \times \text{femur} + 65.53$	± 3.94
Negro	$2.10 \text{ femur} + 72.22$	± 3.91
Mongoloid	$2.15 \text{ femur} + 72.57$	± 3.80
Mexican	$2.44 \text{ femur} + 58.67$	± 2.99

Table 5.4 stature formulae for the male femur (Totter & Gleser 1952 cited Bass 1995:233)

As the race of the individual was unknown, the figure of 47.7cm was inserted in to all four formulae and a range of statures were produced (table 5.5)

Stature estimate of Newport Individual			
Race	Mean cm	Range low cm	Range high cm
White	176.2	172.2	180.1
Negro	172.4	168.5	176.3
Mongoloid	175.1	171.3	178.9
Mexican	175.1	172.1	178.0

Table 5.5 calculation of estimated height of the Newport individual using the right femur length

The results in table 5.5 suggest that the estimated stature of the individual fell within a range of 168.5 cm and 180.1 cm with the mean heights between 172.4cm and 176.2cm (approximately between 5'6" and 5' 8"). Although this stature is relatively short compared to the British population today, Molleson & Cox (1993) suggest these figures fit well into the average stature for Romano-British and medieval populations. Alternatively, he may have been a relatively tall, muscular male from the African continent.

Observation of table 5.3 indicates that the femora measurements appear to match well with the measurements of the Welsh and medieval samples. The figures suggest that although he appears tall and robust compared to the modern Welsh population today, table 5.3 suggests that in the medieval period he would have been average height and build.

In conclusion, the estimated height of the Newport individual was based on an approximate measurement of the right femur. Using the formulae suggested by Totter & Gleser (1952 cited Bass 1995:233) to estimate stature, it can be proposed that the height of the Newport

male was approximately between 172.4cm and 176.2cm (5'6" and 5'8") depending on his ethnic origins.

5.4 Race or ethnic origin

Variation within the skeleton among diverse populations has been noted through a number of morphological indicators and mathematical formulas (Ubelaker 1978:119). Although a large amount of information has been collated on the stature of differing populations, these data tend to be based on either relatively small skeletal samples or groups unrepresentative of the general population (Harrison *et al* 1988).

The estimation of ancestral affiliation of a skeleton from an ambiguous and unmarked burial location is at the very least difficult. Although some population differences can be seen on the skeleton, the mixing of groups over time has reduced these characteristics and the accuracy of identification (Ubelaker 1978). Although the discovery of the skeleton at Newport might suggest the person was Welsh, in reality, this individual's ancestry might well have been African, American, south European or Asian, having travelled in to Wales. As discussed earlier, the size differences in the skeleton of differing populations overlap and therefore it would not be difficult to confuse the skeletal remains between a small Asian male and a large European female (Coard 2005 pers comm.). It had already been established that the Newport remains belonged to a male standing between 5'6" and 5'8", but the key question was: did his skeletal measurements fall within the European Caucasian range, as would be expected from a Welsh population or did they fall within the range of another race, such as Negroid, Asiatic or Mongoloid?

Studies of the skeleton for racial affiliation are usually concentrated on the skull as this area carries the best landmarks for estimating racial origin (Bass 1995). However, research has also been conducted on the femur, which is what was used in this dissertation, as the skull was not available for examination. Various Newport measurements from the femur were compared to a range of data collected from archaeological samples. Although observations can be made from the femur (see below), not all of these were possible on the Newport femora.

- The femora intercondylar shelf angle (the angle is less in the Black communities (Craig 1994 cited Bass 1995:234).
- Curvature of the femora and neck torsion (Asian femora are very curved and Blacks are much straighter (Ubelaker 1978).
- Measuring the femur shaft length, not including the neck and head (Bass 1995).
- The Platymetric Index (Brothwell 1963 cited in Bass 1995:225)

The accuracy of identifying any racial characteristics on the Newport skeleton was difficult, as although the bones were large and robust, few of the essential characteristics had preserved. However, measurements were taken to calculate the Platymetric Index and the results are shown below:

$$\text{Platymetric Index} = \frac{\text{subtrochanteric anterior} - \text{posterior diameter} \times 100}{\text{Subtrochanteric mediolateral diameter}}$$

$$\text{Platymeric Index of the Newport left femur} = \frac{34.35 \times 100}{44.49}$$

$$\text{Newport femur Platymeric Index} = 77$$

According to Brothwell (1963 cited in Bass 1995:225) the result of 77 for the Newport Platymeric Index matches the Platymeric Index of a Neanderthal man. This was an unexpected result and if correct it could be suggested that a prehistoric individual had been laying beneath the Welsh sediment for thousands of years rather than hundreds of years, as a medieval date would suggest. Radiocarbon dating would narrow this time line but would not explain the racial origins of the individual. It would not be satisfactory, therefore, to accept this solitary suggestion of a Neanderthal. Other Platymeric Index close to 77 included Andamanese and Eskimo (Brothwell (1963 cited in Bass 1995:225).

A second approach was to compare the Newport estimated femur length and height to that of other races to see which range of measurements the individual fell into (table 5.6). This may either validate or discard the result from the Platymeric Index.

Table 5.6 suggests that the stature of the Newport individual falls between the range of the modern black Americans and the modern Asian races. The Welsh medieval sample fell above the range of the Newport individual, although this was an estimated figure. Therefore the results produced by this methodology did not match those from the Platymeric Index.

Race	Date	Mean male Femur length	Mean male stature
		cm	cm
<i>Newport Individual</i>	<i>Unknown</i>	47.70	174.30
Anatolian	Chalcolithic (3000BC)	42.26	163.43*
Welsh Cwm Nash	Modern 17 th century	44.18	168.03*
French	Neanderthal	44.27	168.24*
English Spitalfields	Modern 19 th century	44.74	170.27
English York	Medieval 15 th century	45.20	169.47
American black	Modern 20 th century	47.73	174.45*
Asian	Modern 20 th century	47.70	174.30+
Welsh Llanddewi Fach	Medieval	49.90	181.30*

Table 5.6 detailing a range femur length and stature from a variety of dates and races.

In data where only the femur length has been given, the estimated stature has been calculated using:

** = only femur length given therefore estimated stature calculated using Trotter and Gleser (1952)*

+ = Newport femur length used for formula published by Trotter (1970 cited in Ubelaker 1978:61)

Observation of the growth morphology of the femur was undertaken without quantifiable measurements. The Newport left femur was placed on a flat table next to a modern Welsh femur, both in their correct anatomical position. The distal shaft of the Newport femur was raised slightly to compensate for the loss of the epicondyle. Study of both femora suggested the Newport femur shaft was less

curved but looked more robust, especially along the posterior midshaft, and midshaft circumferential measurements confirmed this. This reduced bowing might suggest that the individual was more Negroid than European modern (Ubelaker 1978). Examination of the femoral head and neck suggested the Newport femoral head was more angled with the proximal end lying on the distal greater trochanter and not the proximal greater trochanter as seen on the modern bone. The Newport femoral neck looked much shorted and thicker than the European bone and measurements confirmed this. Observations on the lesser trochanter indicated that it did not protrude as much as the European version but was much longer and wider. Therefore, visual observation of the left femur would suggest that the individual could either have European or Negroid affiliation.

It must be concluded at this time that the racial affiliation of the individual is still very much unresolved. Although observations do not rule out the suggestion of a medieval Welsh origin, the skeleton does portray likenesses to other populations such as Negroid and Eskimo. These conclusions suggest this area requires further research at a later stage.

5.5 Muscle Markers – What can they tell?

The muscular morphology of the humerus and ulnae indicated that the individual had probably been stocky and very muscular. Calculation of his body mass estimated that he may have weighed around 78 – 80kg (11 – 12 stone) (Junno 2004). With his stature already calculated at 172.4cm and 176.2cm (approximately between 5'6" and 5' 8"), he would have appeared fairly short, stocky but muscular. The femora also indicated large muscle attachments to the femoral neck and around the gluteal tuberosity. Observation of

muscle markers have been used to reconstruct the lifestyles of past populations and the patterning of these muscles on the Newport skeleton may be indicative of his life's activities (Weiss 2003¹). Laughlin *et al* (1991 cited Weiss 2003²: 293) suggest any strenuous activity such as kayaking or hunting marine animals would result in a robust skeleton. If the individual dates to the medieval period, this muscular body shape may be indicative of a highly physical lifestyle such as ocean rowing, sailing or farming (Weiss 2003²). If radiocarbon dating suggests an earlier date, such as prehistoric, then a stocky robust body with strong upper limb strength would not be unexpected for a hunter-gatherer. The bowing to the right humerus and radius mid-shaft may also be indicative of specific habitual patterning such as rowing, spear throwing or lifting (Junno 2004). In addition, it could also be suggested that the individual was right handed (Steel 2000, Junno 2004).

5.5 Summary

This chapter discussed the means of inferring a biological identity to the Newport skeletal remains. Through examination of the skeletal remains, by way of metric and non-metric analysis, the following inferences have been made. It can be inferred that the skeletal remains were from a single male individual, aged between 20 and 51 years old who stood between 172.4cm and 176.2cm (5'6" and 5'8"). He weighed around 78 - 80kg (11 - 12 stone) and was stocky but muscular. His racial affinity is inconclusive, as is the period of time that he lived.

Table 5.3. Femoral measurement comparison

Location	Date	Maximum Length mm	midshaft circumference mm	Midshaft ant-pos diameter mm	Sex	Neck diameter mm
<i>Newport</i>	<i>n/a</i>	446 *	106.0	29.5	M?	40.23
Cwm Nash	Modern	441	97.5	28.4	M	
France	Neanderthal	443	/	/	M	
France	Neanderthal	410	/	/	F	
Llanddewi	Medieval	499	105.0	30.2	M	
London	17 th century	446	/	27.9	M	
London	17 th century	410	/	24.3	F	
Ohio	Prehistoric	/	85.1	/	M	
Spitalfields	19 th century	452	91.0	28.5	M	
Spitalfields	19 th century	417	82.8	25.3	F	
York	Medieval	450	/	31.2	M	
York	Medieval	415	/	27.6	F	
Nice	20 th century	/	/	/	M	35.09
Nice	20 th century	/	/	/	F	30.85
Mexico	20 th century	/	/	/	M	33.91
Mexico	20 th century	/	/	/	F	28.92

Measurements (in mm) comparing Newport femora with dated remains. Where more than one measurement was presented, the mean average was used.

** = incomplete length measurement taken*

Chapter 6

Inferring a Cultural Identity

Knowledge gained from archaeology and historical texts enables broader understandings of past populations and the way they lived in the past (Ubelaker 1978). The past five chapters have shown that a combination of approaches to skeletal remains enables a specifically focused view on the individual. However, it was appreciated that by combining these conclusions with historical texts would broaden the understanding of the person and his contemporary environment. This chapter will attempt to infer a cultural identity of the Newport Individual by combining the information gathered so far with historical evidence of the 15th century.

As discussed in chapter 5, the period of deposition and the racial affinity of the individual could not be determined with any accuracy. However, the metric measurements of the pelvis and long bones did fall comfortably within the range of a medieval Welsh male. Consequently, a cultural inference of the Newport remains will centre on the inferred Welsh racial affinity that is in keeping with the time of the ship abandonment around 1467 AD.

It should be understood that this date is an inference based on archaeological evidence not positively associated with the skeletal remains and stratigraphy, as this has not been clearly defined (Nayling 2004 pers comm.). It should also be recognised that the skeletal remains could just as easily date earlier or later than the 15th century, and the individual could originate from outside of Wales. Nevertheless, a focus just on primary data viewed independently from their cultural context hinders our understanding of past populations.

Chapter 5 inferred that the individual was aged between 20 and 50 years old when he died, he would, therefore, have been born between 1417 and 1447. The population of Wales was, at that time around 278,000 and only 6.9% of the English population (Thomson 1983). The political atmosphere between Wales and England around 1467 AD was both problematical and prejudiced and during his lifetime, the individual would have felt the affect of English rule. It is also probable that during his lifetime the Newport individual would have spoken Welsh as his first (and possibly only) language as it was spoken throughout Wales at that time (Davies 1990). During the 15th century many important changes were made to the laws that governed Wales and the way Welsh people lived and he may have witnessed several internal revolts against the English along side external wars against France.

However, it is more likely, that internal political decisions would have affected his day-to-day life more, such as the implementation of the Penal Code. This was passed in 1402 by the English parliament, banning any rebellious Welsh from *'gathering together, gaining access to office, carrying arms and dwelling in fortified towns and the same restrictions were placed upon Englishmen who married Welsh women'* (Davies 1990:199). This code was the result of several revolts led by Owain Glyn Dwr. These revolts suggest that at times, many of the poorer communities in Wales lived in general hardship (Thomas 1983) and the affects of these revolts eventually enabled more Welsh people to move around and possess their own land.

War played a central part to many Welsh people's lives and it is not impossible for the Newport individual to have been a soldier, as he could even have taken up arms in one of the many wars at that time (Davies 1990). A system had already developed in Wales that

allowed aristocrats to keep armed forces in their castles. This expansion of well-trained soldiers in Wales became a valuable source of military for the English army; including the Battle of Agincourt (1415), the War of the Roses (1471) and the Hundred Years War (1453). However, observations on the individuals' remains did not highlight any injuries he may have sustained from battle (Mays 1998).

Through out the middle ages, most of the population of Wales and England lived in rural communities dominated by agricultural lifestyles and it was the urban communities who were responsible for the overseas trade (Thomson 1983). Archaeological evidence suggest trade in Newport appeared to centre on resources connected to the river Usk, including merchant trading, boat building and repairs and fishing. Documentation and existing buildings suggest Newport was a small busy community at that time, which included businesses such as a fish farm and evidence that the town had been committed to providing fresh fish for the Royal Household (BBC 2005).

Much of the trade within Newport centred on the Severn Estuary where water freight would have been transferred on to carts to be taken in land (Thomson 1983). Trade provided many foreign commodities such as salt, spices and visitors to the urban population. Employees at these ports would have been involved in the carrying and lifting of heavy goods and this may be reflected in the individual's stocky but muscular build. The muscle markers on the individual are evident that he had very strong upper body strength and this could be the result of carrying heavy loads on and off ships. Indeed this individual may even have been connected to the ship repair trade, possibly falling off whilst carrying out repairs and sinking rapidly in to the mud before being noticed.

Eventually, recurrent political disturbances, naval hostilities, withdrawal of merchant traders and piracy resulted in a gradual decline of British exports around the 1460's and this may possibly explain the similar dates of abandonment of the Newport ship (Postan 1972).

Equally this individual may not have been associated with the ship at all and his robust body proportions may be indicative of someone who worked on the land close to the river such as a farmer. A major form of employment in Wales at that time was connected to agriculture and a large proportion of people were occupied with growing food and keeping livestock. Historical maps and texts demonstrate that increased areas of land were being used for enclosed grazing at the expense of arable farming. In many cases this resulted in the land only just managing to sustain a family (Thomson 1983). Although the population shortages caused by war and plagues had, by that time, resulted in less demand for rural land, much of the farming employment was intermittent and casual labour (Postan 1972). It is feasible that this individual worked the land either as an owner or as a casual labourer.

Many ports, along the Welsh south coast were badly hit as the disease had often been transported by boat (Ziegler 1998). In many towns, such as Newport, too many people lived in unsanitary conditions resulting in outbreaks of disease and further intermittent outbreaks of the Black plague that had raged the country in 1348/49. The Newport skeleton did not shown signs of any pathology and the thin section revealed a healthy bone, although many diseases that kill very quickly do not tend to show up on the bone (Chamberlain 2004 pers comm. Harrison *et al* 1988, Thomson 1983).

It is not possible to infer that the individual lived in Newport, however it is possible to understand the diet he may have eaten at that time. The food he and his family would have had access to would have depended on his social class. Historical records claim England was richer than France in the 15th century however, these texts would have reflected the life of the upper classes rather than the lower classes. There is little evidence of what the poorer people ate but there are suggestion barley, and oats, plus a mixture of wheat and rye were grown, and poor quality meat, cheese and vegetables would have been eaten. In addition, if the individual had lived in Newport he would have had access to fresh fish as well. There were often extreme excess and shortages of food as harvests fluctuated, which would have then been reflected in the different foods available each year. Texts suggest that famine was not common although hunger and poverty were. Naturally though, when the harvests were poor, food prices rose inevitably leading to famine (Postan 1972). Indeed records show 1439 was one of the worst periods of famine, where harvests had failed due to heavy rains and the Newport individual would have had to pay up to double the normal wheat prices (Thomson 1983). Stress on the skeletal remains, related to environmental pressures, such as food shortages and unemployment, were not visible on the robust, healthy skeletal remains and so it may be possible to infer that the individual had had access to a staple diet (Larsen 1997). Historians also suggest poverty levels would have varied among villagers but healthy families with employable sons would have fared better than childless couples, especially if they were old or infirm (Postan 1972).

It is feasible that the individual may have had a connection with slavery as the most prominent condition of 14th century peasants was the semi-free status of serfdom. This was extremely common in medieval villages. The Lords owned most of the land and at times

would have sold off any inferior land to the tenants resulting in reduced quality of food for the workers (Postan 1972). If the individual had been a tenant he would have been bound to the manor lord, making payments to the manor, church and royal taxes. These payments would have been fixed and would have determined the standard of living for him and his family before his death (Postan 1972). The purpose of this dependency was to ensure his family stayed on the holdings and guaranteed rent for the manor lord. After his death the property would have had to be returned to the manor lord. If he had had a son, he would not have been allowed schooling in case he escaped by taking holy orders (Hilton 1973).

All the historical texts all refer to serfdom as a condition of the Welsh serving Welsh and English masters and the act of acquiring slaves from abroad, seen during the Roman and early medieval periods, does not appear to be discussed. This does not mean that it did not occur but may infer that, if the skeletal analysis demonstrated Negroid tendencies, he was more likely to be a foreign sailor or visitor than a slave.

Having analysed the archaeological material along with the historical evidence, a number of inferences can be made of the cultural identity of the Newport individual.

- The time period looked at was the 15th century AD, confirmed by the abandonment of the medieval ship dated to 1467 and inferred by the metric analysis of the skeletal remains (Nayling 2003).
- Politics at that time were problematic and the Newport individual possibly witnessed internal revolts and external wars.

- His way of life would have been restricted by the enforcement of the penal code.
- This period saw many wars and it is possible that at one point he may have been a soldier but the osteology findings do not support this.
- Although most of the population lived in rural communities, Newport was an established town, and this would have reflected on his standard of living.
- The muscle markers and body shape suggest a physical lifestyle possibly related to his employment as a ship labourer or farmer.
- Disease and plagues were common but the skeletal evidence does not show any signs of pathology.
- His healthy bone (seen under the microscope) indicates a good diet reflective of a good standard of living.
- It is possible the laws of serfdom affected him and his family but historical texts do not suggest slavery was common.

In conclusion, by combining the archaeological material and historical data, a broader understanding of the cultural life of the Newport individual was gained, within the context of the 15th century medieval period. Further research into whether he accurately dates to this period or to either a post medieval or prehistoric date awaits the return of the radiocarbon results.

Conclusion

At the time of writing this dissertation, very little research had been published on the excavation and no osteological examination had been carried out on the skeletal remains. Through this dissertation, both an osteology examination and a theoretical inference were made on the skeletal remains excavated at Newport.

By examining the archaeological context and taphonomic processes the skeletal remains had undergone, inferences were made on how quickly the individual had died and how his body had been deposited. After completing metric and non-metric analysis on the long bones and pelvis it was possible to establish the sex and stature of the individual.

The methodology for establishing the age at death was complicated and not always accurate and finally produced a wider age range than had first been anticipated. Comparisons of data with other archaeological material concluded that the race and date of death of the individual were almost inconclusive, although many of the measurements did fall into the medieval range. However, these results could not conclusive state that the individual had been connected to the 15th century ship. However, this study was able to make clear inference of the individuals' lifestyle, health and occupation.

The theoretical cultural inference was based on two elements established within the dissertation. One; the ship under which the remains had lain had been abandoned in 1467AD and two; some of the results from the biological inference matched the medieval

sample measurements. On this basis, a historical setting, contemporary to these two points was inferred.

The research within this dissertation was purposefully limited to concentrate on inferring a biological identity of the Newport skeleton and placing it theoretically within a cultural context. Although there were limitations, due mainly to a lack of published material concerning the archaeology of the ship and comparable skeletal measurements, many inferences could be made from the examination of the bones.

Some of the examinations and analysis were hindered by my lack of experience and the poor condition of some of the bones. However, the information gathered within this dissertation can now form the basis for further research and analysis, especially when the result of the radiocarbon dating has been established.

Bibliography

Alunni-Perret *et al* 2003 Re-examination of a measurement for sexual determination using the supero-inferior femoral neck diameter in a modern European population *Journal of Forensic Science* **48** pp 1 - 4

Bass. W., 1995 *Human Osteology, A Laboratory and Field Manual* 4th edition. Columbia Missouri Archaeological Society Inc.

Bell. M., *et al* 2000 *Prehistory Intertidal Archaeology in the Welsh Severn Estuary* York Council for British Archaeology

Behrensmeyer. A., 1978 Taphonomic and ecologic information from bone weathering *Paleobiology* **4** (2) pp 150 - 162

Black. T., 1978 A new method for assessing the sex of fragmentary skeletal remains: Femoral shaft circumference *American Journal of Physical Anthropology* **48** pp 227 - 231

Bouvier. M., & Ubelaker. D., 1977 A comparison of two methods of the microscopic determination of age at death *American Journal of Physical Anthropology* **46** pp 391 - 394

Chamberlain. A., 1994 *Interpreting the Past: Human Remains* London. British Museum Press

Chamberlain. A., November 2004 *Personal Communication* Sheffield University

Chaplin. R., 1971 *The Study of Animal Bones from Archaeological Sites* London. Seminar Press

Coard. R., 2004/5 *Personal communication* University of Wales, Lampeter

Cox. M., & Mays. S., 2000 *Human Osteology: In Archaeological and Forensic Science* London. Greenwich Medical Media Ltd

Dittrick. J., & Suchey. J., 1986 Sex determination of prehistoric central California skeletal remains using discriminant analysis of the femur and humerus *American Journal of Anthropology* **70** pp 3 - 9

Davies. J., 1990 *A History of Wales* London Penguin Books

Dawes. D., & Magilton. J., 1980 *The Cemetery of St Helen-on-the-Walls, Aldwark The Archaeology of York The Medieval Cemeteries* **12** London Council for British Archaeology

- Ericksen. M., 1991 Histologic estimation of age at death using the anterior cortex of the femur *American Journal of Physical Anthropology* 84 pp 171 – 179
- Grant. J., et al 2002 *The Archaeology Course Book: An introduction to study skills, topics and methods* London Routledge
- Harrison. G., et al 1988 *Human Biology; An introduction to human evolution, variation, growth and adaptability* Oxford Oxford University Press
- Hilton. R., 1973 *Bond Men Made Free* New York The Viking Press Inc.
- Hunter. K., 2004 *Personal Communication* Newport County Borough
- Howell. J.K., 2004 Medieval Britain and Ireland, Newport *Journal of the Society for Medieval Archaeology* XLV111 pp 248 – 249
- Humphrey. L., (eds) 2000 Growth studies of past populations: an overview and an example *Human Osteology: In Archaeological and Forensic Science* London. Greenwich Medical Media Ltd
- Jowey. J., 1960 Age changes in human bone *Clinical Orthopaedics* 17 pp 210 – 218
- Junno. J., November 2004 *Personal communication* University of Oulu, Finland
- Kerley. E., 1965 The microscopic determination of age in human bone *American Journal of Physical Anthropology* 23 pp 149 - 164
- Larsen. C., 1997 *Bioarchaeology; Interpreting behaviour from the human skeleton* Cambridge Cambridge University Press
- Lyman. R. Lee.,1994 *Vertebrate Taphonomy* Cambridge Cambridge University Press
- Manning. W., (ed) 1981 *Report on the Excavations at Usk 1965 – 1976* Cardiff University of Wales Press
- Mays. S., 1998 *The Archaeology of Human Bones* London Routledge
- Molleson. T., & Cox. M., 1993 *The Spitalfields Project Volume 2, the anthropology* York Council for British Archaeology
- Nayling. N., 2003 (ed) Newport Medieval Ship *The Monmouthshire Antiquary Proceedings of the Monmouthshire Antiquarian Association* XIX pp 153 –154 Aberystwyth Cambrian Press
- Nayling. N., December 2004, January 2005 *Personal Communication* University of Wales, Lampeter

Nielsen-Marsh. C., *et al* (eds) 2000 *The Chemical Degradation of Bone* in Cox. M., & Mays. S., 2000 *Human Osteology: In Archaeological and Forensic Science* London Greenwich Medical Media Ltd

Ortner. D., 1976 Microscopic and molecular biology of human compact bone: An anthropological perspective *Yearbook of Physical Anthropology* 20 pp 35 - 44

Pearson. K., & Bell. J., 1919 *A study of the long bones of the English Skeleton Drapers' Company Research Memoirs: Biometric Series X* London Cambridge University Press

Renfrew. C., & Bahn. P., 1991 *Archaeology: Theories, Methods and Practice* London Thames & Hudson

Postan. M., 1972 *The Medieval Economy and Society* London Penguin Books

Scheuer. L., & Black. S., 2000 *Developmental Juvenile Osteology* San Diego CA. Academic Press

Sell. S., 1993 Letter to Dr Wilkinson re: *Radiocarbon dating of Cwm Nash skeletal remains*. Swansea Glamorgan-Gwent Archaeological Trust Ltd

SELRC 2003 Severn Estuary Levels Research Council

Shipman. P., 1993 *Life History of a Fossil* Cambridge Harvard University Press

Singh. I., & Gunberg.L., 1970 Estimation of age at death in human males from quantitative histology of bone fragments *American Journal of Physical Anthropology* 33 pp 373 - 382

Steele. J., 2000 (eds) *Skeletal indicators of handedness* in Cox. M., & Mays. S., *Human Osteology: In Archaeological and Forensic Science* London. Greenwich Medical Media Ltd

Stout. S., 1992 Methods of determining age at death using bone microstructure *Skeletal Biology of Past Peoples: Research Methods* pp 21 - 35

Stout. S., & Teitelbaum. S., 1976 Histological analysis of undecalcified thin sections of archaeological bone *American Journal of Physical Anthropology* 44 pp 263 - 270

Thomas. P., 1995 *Talking Bones; The science of forensic anthropology* New York Facts on File Inc.

Thomson. J., 1983 *The transformation of medieval England 1370 - 1529* Essex Longman Group Ltd

Tortora. G., 2000 *Atlas of the Human Skeleton* Chichester John Wiley & Sons Inc.

Ubelaker. D., 1978 *Human Skeletal Remains: Excavation, analysis, interpretation* 3rd ed. Washington Taraxacum

Uyterschaut. H., 1985 Determination of skeletal age by histological methods *Z-Morph* 75 - 3 pp 331 - 340

Weiss¹. E., 2003 Understanding muscle markers: Aggregation and construct validity *American Journal of Physical Anthropology* 121 pp 230 - 240

Weiss². E., 2003 Effects of rowing on humerus strength *American Journal of Physical Anthropology* 122 pp 293 - 302

Ziegler. P., 1998 *The Black Death* 2nd ed London Penguin Books

WWW Addresses

BBC March 2005 Newport Town History

Visited 2 March 2005

http://www.bbc.co.uk/shropshire/features/places/newport/town_guide.shtml

Brown. P., unknown date *The human skeleton*

Visited July 2004

www.personal.une.edu.au/~pbrown3/skeleton.pdf

Camidge. K. & Brown. R., 2003 *Summary Report of the Excavation of the Bow of the Newport Ship* Oxford Archaeology Unit Ltd. Oxford Archaeology Unit Ltd 2004
visited 4 January 2005

www.oxfordarch.co.uk/pages/newport/text/nesummarytext.pdf

Servini. C., 2005 Email from External Relations SE Wales Environment Agency

Visited 3 February 2005

www.environment-agency.gov.uk

Save Our Ship 2005

Visited 4 January 2005

www.thenewportship.com/research

Ziylan. T., & Murshid. K., 2001 An analysis of Anatolian human femur anthropometry *Turkish Journal of Medical Science* 32 pp 231 - 235

<http://journals.tubitak.gov.tr/medical/issues>

visited 11 January 2005

Interested Bodies

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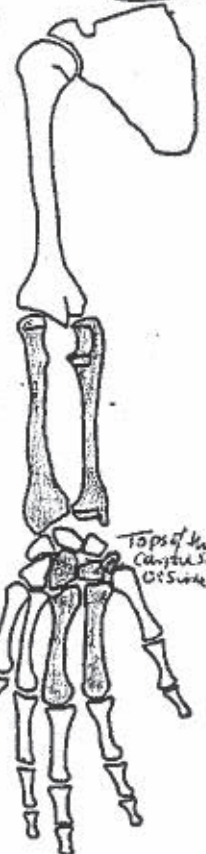
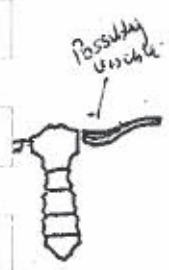
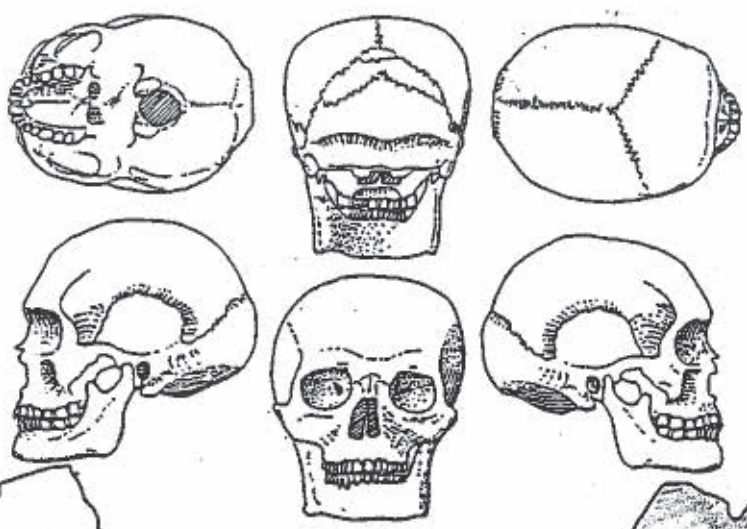
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Tel: 01792 655208

Newport Museum & Art Gallery
John Frost Square
NEWPORT
South Wales. 01633 840064

Photographs

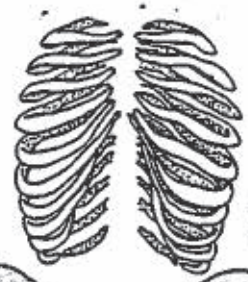
Unless otherwise stated, all photographs were taken by Alison Bennett.

Appendix 1



This hand is resting below the pelvis.

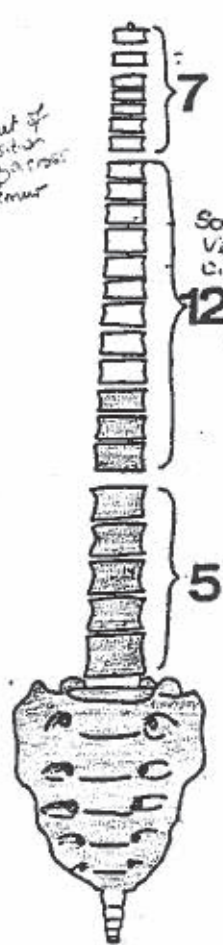
Top of knee capsule are visible



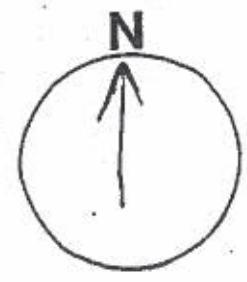
Several ribs both left and right - some are in position, but I am not clear which ones they are. Others are loose and out of place.



out of position in right arm & hand



Some other vertebrae visible - but these are out of position



Appendix 2

NEWPORT THEATRE 467
PLAN OF SKELETON (029)
1:5, DRWG No. 317
17/12/02 HPM

22E
102 SM

22E
102 SM

DL 340V
W3H
REMOV
E TO F

Appendix 3

PART 1: PROVENANCE		03 Context No.	
01 GGAT Excavation No. 467		1018	
02 Site Name NEWPORT THEATRE			
04 Area/Trench/Grid Sq	Grid Ref	05 Levels	Top / Base
06 Form Objective Deposit Negative feature (eg cut)		Structure Object Group Other	
07 Form Subjective Mtl			
08 Period, general (eg medieval)			
28 Method Machine Mattock Trowel Other			
PART 2: DESCRIPTION			
09 Dimensions and depth			
10 Alignment and shape			
11 Material (for Deposits)			
Munsell code		Colour in situ - Mtl.	
Soil texture Sand Loamy sand Sandy loam Sandy silt loam Silt loam Sandy clay loam			
Clay loam Silty clay loam Sandy clay Silty clay Clay Clayey sand Loam			
Coarse components: Size <1mm 1mm-10mm 10mm-60mm 60mm-0.2m 0.2m +			
Abundance (Isolated, Occasional, Moderate, Frequent) (use initial to qualify size)			
Description			
Organic components			
12 Structure (for Structures)			
Matrix (eg mortar)		sampled?	Constituents (eg brick) retained?
14 Description Plastic PA 1 red-brown earthy silty Mtl. organic.			
UPPER SURFACE OF MTL IS UNEVEN MTL WITH CLASTS OF DOZ. SURFACE SHOWS SIGNS OF WATER ACTION. IS CUT BY A NUMBER OF CLAY FILLED NATURAL RILL-GULLIES (eg 1023 + 1024) MTL CONTAINS WOOD JOINTS. CONTAINS COMPRESSOR INTO MTL Continuation sheet (X) N			
PART 3: RELATIONSHIPS			
Earlier than		21 Underlies 1023, 1024	
17 Contains			
24 Cut by		1028	
26 Butted by			
Contemporary with			
15 Part of			
16 Comprises			
19 Identical to			
20 Equivalent to			
27 Bonded with			
SURFACES Adjoining		1029	
Later than		22 Overlies	
18 Contained by		1029	
23 Cuts			
25 Abuts			
PART 4: CROSS-REFERENCE			
29 Samples		Nos. 425 + 426 - TMS; 432	
30 Finds		Retained finds Y/N Not retained (details)	
31 Drawing Nos. Plan		307 - 308 Section/elevation/profile 309 Other	
32 Photographs		Y/N (see below)	
33 Recorded by		Date 2/12/2	
PART 5: POST-EXCAVATION			
On computer? Y/N			
Matrix? Y/N		Phase	Period
Photographs film/chart		Stratigraphic group	