

**A STUDY OF A SELECTED GROUP OF THIRD
INTERMEDIATE PERIOD MUMMIES IN THE BRITISH
MUSEUM**

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One Cd accompanies the thesis. This CD contains 7 files; each includes a large number of photographs, CT and X-ray images of the mummies. The photographs document the exterior of each cartonnage case while the CT and X-ray images document the interior and the skeletal condition of the mummies. 3D rotations and 3D images are also included.

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A Study of a Selected Group of Third Intermediate Period Mummies in The British Museum

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Abstract

Mummies have been considered as “*biologic museums*” as they display vital evidence and clues about the life and death of the ancient Egyptian population who lived thousands of years ago. They also hold the secrets of the evolution of disease. The Third Intermediate Period mummies represent the mummification technique at its best. The main aim of this research is to produce a scientific study of the Third Intermediate Period mummies in the British Museum. It attempts to answer some important questions and considers to what extent a detailed radiographic investigation of a group of mummies can provide evidence about disease processes, diet, mummification techniques, funerary and medical practices within that period?

Non-invasive techniques were used during this study to investigate a group of seven mummies from the collection of the British Museum. The mummies are encased in cartonnage cases except one mummy which is inside a wooden coffin. The radiological methods (i.e. X-ray radiography and CT scanning) provided new information regarding the manufacturing of cartonnage cases during that period. The detailed radiographs showed aspects of the mummification techniques that were not reported during previous investigations.

A historical account of the Third Intermediate Period was given in chapter one while chapter two provides information regarding the mummification techniques used during this historical period. Chapter three gives information on previous radiological studies and chapter four gives detailed description and photographs of the selected mummies, the subjects of this investigation. Chapter five contains a full description of the methods used during this study and the results and discussions were presented in chapter six.

A catalogue with detailed information is attached as an appendix to the thesis to present the physical anthropological data and radiological finds with regards to each mummy from this selected group.

Declaration

That no portion of the work referred to in the thesis has been submitted in support of an application for another degree or qualification of this or any other university or other institute of learning.

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Dedication:

To Nada and Nadine.

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1 Introduction:

1.1 Investigation of the mummified remains:

1.1.1 Ancient examination:

Investigating ancient Egyptian mummies may have started not long after the mummification process was first practised. The ancient Egyptians learned the different steps of the mummification techniques through trial and error. Historical records from the 21st Dynasty mention the rewrapping of the royal mummies. There is no doubt that the embalmers who investigated these unwrapped bodies of the ancient kings and queens took advantage of the opportunity to see how they could reach perfection in their sacred profession (D'Auria *et al* 1992:16). This perfection is shown in the mummies of the 21st Dynasty as the embalmers made important changes to the mummification process based on their investigation of the earlier mummies.

1.1.2 Medieval interest:

The next period of interest in Egyptian mummies, both human and animal, started during the medieval era in Europe as mummy powder was used as a medicine (Taconis 2005:40). Abd Al-Latif (1162-1231)¹, a famous Arab philosopher and physician who lived in Cairo during the 12th century, recommended the use of bitumen or mineral pitch in a wide range of medical cases. The Persian/Arabic word for bitumen is *mumma*, which is the same word that was used to describe the preserved bodies of the ancients (Brier 1996:149). This linguistic confusion, and the resemblance between bitumen and the dark coloured resin that was found on the mummy wrappings, led to the destruction of thousands of human and animal mummies by medieval traders and physicians² (Taconis 2005:40).

¹ Abd Al-Latif was born in Baghdad in 1161 and died in 1231 in the same city. He was a famous philosopher, historian and physician (El-Daly 2005:173). His full name is “ Muwafaq Al-Din Abd Al-Latif Yousuf Ibn Muhammad Ibn Ali Al-Bahgdadi” but he has been always quoted as Abd Al-Latif (El-Daly 2005:173). He travelled to Damascus, Aleppo, Turkey, Afghanistan, Iran, Jerusalem and Cairo. His book “Observations and Reflections on Things Seen and Events Witnessed in the Land of Egypt” was translated into Latin, French and English (El-Daly 2005:175). His approach towards describing human and animal mummification was accurate and scientific (El-Daly 2005:175-6).

² Recent geochemical research on 20 samples from Egyptian mummies suggests that bitumen from the Dead Sea area was used during the mummification process. A wide range of bitumen quantities were detected in these samples from as high as 30% to zero (Connan 1999:48).

Abd Al-Latif also recommended that if the bitumen was not available, Egyptian mummies would be a good substitute³ (Dannenfeldt 1959:17). As a result, the use of mummies was described in almost every medical book of that era since the appearance of Abd Al-Latif's book (Dannenfeldt 1959:18).

A recent study of the Arabic manuscripts during the medieval period reveals for the first time that the Arab scientists had a great interest in the Egyptian mummies and examined some of them. Abd Al-Latif wrote a book about ancient Egypt, in which he says:

“People find underground tombs with many of the dead of the Ancients, wrapped in shrouds of linen cloth, which maybe of a thousand arms-length; each limb is wrapped separately, hand, leg, and the finger in fine pieces, then the body is wrapped as a whole.”
(El-Daly 2005:100).

1.1.3 Mummies in the Renaissance:

The mummies were a subject of interest during the Renaissance in Europe. The scholars during this period had some knowledge of the ancient Egyptian mummification practices from the accounts of classical travellers such as Herodotus, Diodorus and Pliny (Dannenfeldt 1959:16). This interest unfortunately was directed towards acquiring the mummies for their medicinal value which created a market for them. As the demand was sometimes more than the available supply of authentic mummies, cases of fraud were reported.

Towards the end of the 16th century, an English trader shipped a full body and 600 pounds of mummy to London where they were sold (Dannenfeldt 1959:16). The use of mummy powder continued until the beginning of the 19th century as R. R. Madden, the British traveller, mentioned in his account (Dannenfeldt 1959:21). He stated that the Arabs use a mixture of the mummy powder and butter as a medicine, which they called “*Mantey*”, for ulcers. As well as in the Arab world, the mummy powder continued to be seen on the shelves of pharmacies in Italy (Dannenfeldt 1959:21). Sir Thomas Browne in the 17th century summarised what happened to the mummies:

³ In 1203, Abd Al-latif wrote: “ *The mummy found in the hollows of corpses in Egypt, differs but immaterially from the nature of mineral mummy; and where any difficulty arises in procuring the latter, may be substituted in its stead.*” (Dannenfeldt 1959:16).

"Mummy is become merchandise, Mizraim cures wounds, and Pharaoh is sold for Balsams." (Smith 1914:195).

1.1.4 From the 17th Century to the 20th Century

During the 17th century, great interest was directed towards everything Egyptian, especially by the French scholars (El Mahdy 1993:29). It is recorded that mummies were unrolled in 1698 by De Maillet, the French Consul in Cairo (El Mahdy 1993:29). One of the first scientific accounts of mummification was published in the *Description de l' Egypte* by Rouyez who joined the Napoleonic expedition to Egypt as a pharmacist between 1798 and 1801 (Taconis, 2005:40-41). In his essay, he suggested that the mummification process was based on dehydration of the body but he assumed that this was done by raising the temperature of the body to a high level (Brier 1996:154).

In 1737, Alexander Gordon, an English scholar, was planning to carry out a comparative study of the mummies in England at that time. He found three mummies in total, one of them originally owned by Dr. Richard Mead (1673-1754) who donated it to the Royal College of Physicians (Dannenfeldt 1959:22).

In 1825, A. B. Granville, a physician to the Duke of Clarence, published his detailed account of the dissection of a female mummy that was given to him by Sir Archibald Edmonstone (Granville 1825:269). In 1794, John Frederick Blumenbach, the founder of physical anthropology, unwrapped three small mummies from the collection of the British Museum (Taconis 2005:41& Moser 2006:249). His interest was focused on the anatomy of the human skull (Taconis 2005:41). Blumenbach discovered that one of the mummies was a modern fake: wrapped to look like a human mummy, the bandages contained the bones of ibis birds (Moser 2006:46). In 1824, W. Osborn and a multidisciplinary team scientifically unwrapped and investigated a mummy that was purchased for the Leeds Philosophical and Literary Society by John Blayds, one of the members. The results of this investigation were accurately recorded and published in 1828 (Taconis 2005:41).

In 1834, the British surgeon Thomas Joseph Pettigrew⁴ published his well-known book *History of Egyptian Mummies and an Account of the Worship and Embalming of the Sacred Animals* which is considered the start of scientific investigation of the Egyptian mummies⁵ (Seipel 1996:41). There is no doubt that he gained his knowledge through unwrapping a large number of mummies that were available to him at that time. He unwrapped mummies he purchased himself from auctions and mummies that were given to him by friends (Brewer 1978:133). In March 1833, Pettigrew paid £36.15s to purchase a mummy and its case at a Sotheby's auction which he unrolled in Charing Cross Hospital the following month (Brewer 1978:133). Detailed accounts of some of these public unwrappings, such as the 1834 unrolling of the mummy of Horseisi that was presented by Mr. Henderson to the Royal College of Surgeons in London, tell us about the crowded lecture theatres and the experience of the large audiences (Brier 1996:161 & Brewer 1978:134). Such public events generated great interest in mummies among the audience and scholars alike. Before the unwrapping, the audience would have enjoyed a detailed lecture about the mummification techniques in ancient Egypt. Most of the information available to Pettigrew at that time was contained in accounts of the classical historians, travellers and writers such as Herodotus, Diodorus Siculus and Plutarch, supported by his own experience (Pettigrew 1838:270 & Pettigrew 1849:340).

Pettigrew published detailed accounts of the unrolling of a mummy brought to Jersey by Mr. Gosset in 1837 which he found to be similar to the Egyptian mummies in the British Museum (Pettigrew 1838:267). It was in this publication that Pettigrew suggested for the first time the association between each internal organ, including the heart, and a specific protective deity (Pettigrew 1838:271). He also refers to an anthropoid wooden case shown to him by Dr. Samuel Birch, with an inscription that relates each organ to its guardian deity (Pettigrew 1838:271). In 1911, Smith explained and provided evidence that the heart and the kidneys were intentionally left in the body by the embalmers as they were considered “*organs of life and mind*” (Smith 1911:44).

⁴ Pettigrew was born in 1791 in London. He was surgeon to the Duke of Kent and inoculated Queen Victoria. He also worked as a librarian and was an active archaeologist as well. In 1818, he met Belzoni and he became interested in Egyptology. He was famous for public unwrapping of many Egyptian mummies. He died in 1865 in London (Dawson & Uphill, 1995:332).

⁵ In 1741, Dr. Charles Perry brought a mummy with him from Egypt which was later acquired by Pettigrew who unwrapped it in his house (Brier 1996:158).

In August 1842, Mr. Birch of the British Museum unwrapped a mummy belonging to a Priestess of Amun that was given to the Natural History Society of Shrewsbury by Dr. Butler (Court & Lady's 1942:93). More than 200 people attended the event, most of whom were ladies, as the article stated that there "*would be nothing whatever indelicate in the interesting operation*" (Court & ladies 1842:93). Birch started by giving a lecture about the mummification techniques used by the ancient Egyptians as was the custom at these events (Court & ladies 1842:93). The unwrapping took about 3 hours (Court & ladies 1842:94).

In 1843, Mr. Birch and Hugh Diamond opened a mummy that was presented to the latter by a friend (Diamond 1846:408). Diamond sent a letter containing the description of the mummy and the inscriptions on the coffin to John Young Akerman which was published in 1846. In his letter Diamond mentioned that he believed that dehydration was the "*grand secret of preservation*" (Diamond 1846:409). This was supported by rapid decomposition of a rehydrated sample from the mummy (Diamond 1846:409). Diamond mentioned other evidence to support his claim about dehydration: successful experimental mummification was carried out by Diamond on the hand of a newborn child and survived for more than 18 years (Diamond 1846:409).

In September 1844, *The Mirror* announced that Pettigrew unwrapped a mummy, brought by Captain Needham, at the Canterbury Theatre. Mr. Pettigrew gave a lecture and proceeded with the unwrapping operation assisted by his son, Dr. Pettigrew. At the end of the procedure the mummy was held upright to show it to the audience; the magazine reported "*...its erect appearance on the stage was received with enthusiastic applause*" (*The Mirror* 1844:216).

In 1849, Pettigrew unwrapped a mummy that was given to the British Archaeological Association by Joseph Arden. The unrolling took place during the Association's Worcester Congress and was preceded with a lecture given by Pettigrew in which he explained the techniques and different classes of mummification (Pettigrew 1849:337-348). The description of the mummy at the end of his publication suggests that this mummy probably dates to the Third Intermediate Period as the internal organs were wrapped and placed inside the body, a technique of preservation introduced during this historical period (David 2000:374).

In 1875, Birch unrolled a mummy presented to the Duke of Sutherland in front of a selected audience at Stafford House (Birch 1877:122). He concluded that it belongs to an elderly male who lived around the 28th Dynasty (Birch 1877:122-123). Dawson (1927:156) disagreed with this date claiming that the mummification techniques suggests a much earlier date, probably 11th Dynasty. After the unrolling, the Duke of Sutherland donated this mummy to the museum of the Royal College of Surgeons where it was examined by Joseph Bonomi and Prof. William Henry Flower, the conservator of the museum. In his report, Bonomi (1875:251) pointed out the vast width of the shoulders and the “*straightness of the vertebral column*” as elements of interest in this skeleton. On the other hand, Flower (1875:253) pointed out two healed fractures, one in the forearm and another one in a rib, and inflammation of two lower lumbar vertebrae which indicate a possible case of Ankylosis. Treatment of fractured bones was one of the ancient Egyptian surgeons’ great achievements (Smith 1908:732). Smith (1908:732-734) examined two splints found by Reisner at Naga edder (north of Luxor) dating from the 5th Dynasty (c. 2465-2323 BC) which were considered by Smith to be the “*earliest surgical appliances ever discovered*” (Smith 1908:732). One of the splints, made of wood and linen bandages, was applied to fix a compound fracture of the right femur of a 14 year old girl (Smith 1908:732) and the other one was used to mend a broken forearm (Smith 1908:733).

The interest in Egyptian mummies not only developed in Britain but also in many other places in Europe such as Germany. In 1696, the records tell us about a 26th Dynasty mummy which belonged to Jacob Stolterfoht, the apothecary of Lübeck. The mummy was conserved and a new coffin was made for it in 1651 (Germer 1995:96). In 1716, a physician called Hertzog unrolled a mummy (probably to use the powder as a medicine) and found 74 amulets within the wrappings (Taconis 2005:41). In Florence, a mummy was unwrapped by Professor Migliarini in September 1827 in front of a large audience. His account was published in 1855 by Birch who added his own notes and observations (Birch 1855:161).

The discovery of the first cache of royal mummies at Deir el Bahari in 1881, followed by the discovery of the second royal cache in the Valley of the Kings⁶ in 1898, raised more interest and drew attention to Egyptian mummies (Seipel 1996:42). Gaston Maspero, the French

⁶ This cache was discovered by the Egyptologist Victor Loret (El Mahdy 1993:38).

Egyptologist⁷ who was in charge of the Egyptian Antiquities Service at that time, transferred the mummies to Boulaq Museum in Cairo, where they were examined, unwrapped and studied⁸ (Seipel 1996:42). In 1889, Maspero published his two volume book *Les Momies royales de Deir el-Bahari*, which contains his accounts of the unwrapping of the royal mummies (Smith 1912:VI & Taconis 2005:41). Ten years after the discovery of the first royal mummy cache at Deir el Bahari, another one was found at the same site. This tomb contained the mummies of 153 high officials, priests and family members of the high priest Menkheperre who lived during the 21st Dynasty (El Mahdy 1993:38).

In 1912, Elliot Smith⁹ published his extensive study of the royal mummies in the Cairo Museum. His excellent descriptions and discussions of the mummification techniques are considered to be a huge step forward in the development of the scientific study of mummies (Seipel 1996:42). For many years before this publication, Smith had examined mummies from different archaeological sites in Egypt to determine when the mummification process started in ancient Egypt (Smith 1914:191). In 1906, Smith examined a mummy discovered by Lythgoe and Mace near the pyramids of El Lisht. The 12th Dynasty mummy, was unwrapped by Smith in the tomb (Smith 1914:191). He reported the poor condition of the mummy but was able to identify the abdominal incision used to eviscerate the body (Smith 1914:191).

The first multi-disciplinary research team in scientific mummy investigation was established in Manchester in 1908 by Margaret Murray, the first curator of the Egyptian Collection of Manchester Museum (David 1985:42). The team included scientists and experts from different scientific fields such as an anatomist, chemical analyst and an expert in textiles (David 1985:42 & David 2000:372). The 12th Dynasty mummies of the “Two Brothers” were unwrapped and examined by Murray and her team in front of a large audience (David 1985:42).

⁷ Maspero (1846-1916), started his career in Egypt as the head of a French archaeological excavation in the Valley of the Kings in 1880. The next year he became the director of the Boulaq museum and the Antiquities Service (Dawson & Uphill, 1995:197).

⁸ Maspero and Brugsch unwrapped the majority of the royal mummies except nine most of which were unwrapped in 1905 by Smith (Taconis 2005:41). The records of the unwrapping of these mummies indicate that it was done in a hasty and rather unscientific way and that a large amount of information was unrecorded and unfortunately lost forever (Taconis 2005:43).

⁹ Grafton Elliot Smith (1871-1937) was an Australian anatomist. In 1909 he was appointed as Professor of Anatomy in the Cairo Medical School. As he lived in Egypt, he examined numerous mummies and human remains that were discovered in many archaeological sites (Dawson & Uphill, 1995:395-6).

1.2 Aims and objectives:

The aims of this research are to study the selected collection of mummies that lived and were mummified during the Third Intermediate Period. The study will focus on the mummies in cartonnage cases aiming:

- To demonstrate the findings of the detailed visual and radiographic (X-ray and CT scanning) examination of the selected group of mummies.
- To gain more knowledge about the mummification techniques used during the Third Intermediate Period through investigating more mummies that belong to this important period in the history of mummification.
- To record the mummification techniques used to preserve each mummy and compare the results to reach conclusions regarding the possible reasons for any differences observed. This would answer a number of questions: Did the embalmers treat male and female mummies differently during this period? How did the social status of the deceased affect the way the body was mummified? Is it possible to gather enough evidence through the visual examination of the exterior cartonnage case and the radiographic examination of the mummy, to confirm if two mummies were treated within the same workshop or mummification establishment?
- To observe if any foreign objects were deposited with each mummy and if present, to explore the possibility of using post processing image techniques to investigate their material, size and if they were inscribed. Of particular interest will be the heart scarabs which were recorded by Dawson and Gray during the radiographic investigation of the mummies in 1968. Attempts will also be made to explore the possibility of reading any inscriptions found. This could provide confirmation of the identification of the mummies as the inscriptions are likely to mention the name of the deceased.
- To compare and clarify the results of the earlier X-ray radiological investigation carried out by Dawson and Gray in 1968, by using state-of-the art X-ray and CT equipment and the most recent computer software to visualise the results.
- To explore the techniques used to produce the examples of the Third Intermediate Period cartonnage cases in this collection. Most radiographic studies only focus on the

human remains, but this study will investigate the evidence relating to cartonnage observed on the CT images and the results will be compared with previous information and the most recent studies on the manufacturing of cartonnage cases.

- To record the condition of each cartonnage case, coffin and mummy inside these cases. If proved possible and practical, the results of this study could be used for comparison with the results of any future radiological investigation, to trace any changes that took place.
- To determine the possibility of using the CT images as an aid in the restoration and conservation processes. This may provide valuable information about the condition and state of preservation of internal structures, cracks and defects that are not visible with the naked eye or inaccessible through other investigation methods.
- To build a profile of each individual of the group and gain more information about samples of the ancient Egyptian population. The information gained about each individual during this study will be presented in a detailed catalogue in appendix VI. The catalogue will include information and a number of radiographic images (X-rays and CT images) that demonstrate the findings from each mummy in this collection.
- The new findings and information regarding each mummy will be used to update the database of the Department of Ancient Egypt and Sudan at The British Museum; this in turn will be used to update the British Museum online database which is freely accessible on the World Wide Web. The up-to-date information will be available to scholars, researchers and the public as soon as the information is uploaded on the website.
- To produce digital records for each mummy that will include a complete photographic documentation of the exterior case or coffin and images of each mummy during the visual and radiological examination. This will be stored on a CD for the use of future researchers.

2 Chapter one: Egypt during the Third Intermediate Period

2.1 Sources of Ancient Egyptian History:

2.1.1 Ancient Historians:

The basis of ancient Egyptian history- still accepted today- was constructed during the third century BC by Manetho, an ancient Egyptian high priest of Sebennytus who lived during the reign of King Ptolemy I and Ptolemy II Philadelphus (Murnane 1997:21, Murray 1979:11). The work of Manetho, which is known as the *Aegyptiaca* (Egyptian Matters), divided Egyptian history into 30 dynasties and covers more than 36,500 years (Moyer 2002:76, Dillery 1999:93). The *Aegyptiaca* was written in Greek (Oakes & Gahlin 2002:323) and was kept at the Bibliotheca Alexandrina until it was destroyed later during the famous fire (Murray 1979:11).

Manetho mentioned the names of 323 kings from the beginning of the historical period until the end of the Third Intermediate Period (Moyer 2002:76), using a wide range of references such as palace and temple archives, inscriptions on the walls of different temples (King Lists) and monuments and written documents such as the Palermo Stone (Murnane 1997:21, Shaw 2000:4). This stone or another of the same kind must have provided an essential reference for Manetho as it records the names of the Early Dynastic Period Egyptian Kings (Shaw 2000:4). The surviving fragments of this stone provide information up to the 5th Dynasty only but originally the complete stone, which would have been around 2 meters long, would have provided a full list of kings (Shaw 2000:4). There is also a possibility that Manetho could have had access to a papyrus called the Turin Canon which dates back to the Ramesside era. This papyrus documents the names of the kings up to the Second Intermediate Period (Shaw 2000:9).

Manetho's original book has not been found but references to it occurred in the writings of some classical authors such as Flavius Josephus (*Contra Apionem*), Julius Africanus, George the Syncellus and Eusebius (Rowton 1948:58; Hornung *et al* 2006:35; Kitchen 1991:202). Manetho, and subsequently the classical writers who copied him, referred to the Egyptian kings by their Greek names which sometimes makes them difficult to identify (Kitchen 1991:202).

Modern historians shed some doubt on the authenticity of the *Aegyptiaca* as it was not mentioned by any of the great Greek historians such as Strabo or Pliny for many years before it was referred to by Josephus (Hornung *et al* 2006:34-35). On the other hand, some recent archaeological finds support Manetho's accounts for example the accurate length of King Ramesses II's reign (66 years and 2 months) (Hornung *et al* 2006:36).

2.1.2 Classical Historians:

Herodotus (c490-420 BC), the famous traveller and historian, also contributed to the documentation of ancient Egyptian history almost two centuries before Manetho (Marincola 2003:x). The second book of his *Histories* is entirely devoted to Egypt in addition to more accounts in the third book (Marincola 2003:xv & Dillery 1999:93). Herodotus visited Egypt as a traveller around 450 BC when Egypt was under Persian occupation (Rawlinson 1886:384-385). He claimed to have reached as far south as Elephantine and his book gives detailed accounts of different aspects of ancient Egyptian life such as religious festivals, Egyptian medicine and the mummification process (Sélincourt 2003:95-169 & Nunn 2003:12). Some of Herodotus' facts were later corrected by Manetho in the *Aegyptiaca* which also provide evidence that Herodotus' work was available to Manetho who believed that these mistakes were due to lack of knowledge (Dillery 1999:97). Modern historians describe Herodotus' accounts of the Egyptian rulers during the 26th Dynasty as correct and accurate (Hornung *et al* 2006:33), but his comments on earlier periods are considered to be unreliable and inaccurate (Hornung *et al* 2006:33). On the other hand, some researchers doubt that Herodotus ever visited Egypt and believe that his inaccurate accounts were based on the contemporary Greek traditions about ancient Egypt; they have suggested that the fairly accurate sections are taken from the accounts of Hecataeus, who visited Egypt before Herodotus (Armayer 1978:69).

Diodorus Siculus, the Greek historian, also wrote a chapter about Egypt in his book *Bibliotheca Historica* (Hornung *et al* 2006:34). Other accounts of his experience in Egypt can be found in other chapters of his book (Dannenfeldt 1959:9). He visited Egypt during the first century BC as a traveller and met a number of priests (Africa 1963:254, Davies 1955:153). In his book, he repeated what he heard from those priests as his accounts are described as a mixture of facts and fiction (Davies 1955:153).

As well as dynasties, the ancient Egyptian history is divided into “Kingdoms” following the tradition that was first documented on the walls of Ramesses II’s temple at Abydos (Murnane 1997:21). Each kingdom consists of a number of dynasties and usually starts with a major unification act led by a powerful king (Murnane 1997:21). It is also important to note that names of kings whom the priests considered to be illegitimate would not be included in the list (Shaw 2000:6).

2.1.3 King Lists:

During various periods of Egyptian history and for religious reasons, the kings ordered a list of their predecessors to be recorded on their monuments. Tuthmosis III recorded such a list at the Temple of Amun at Karnak (Kitchen 1991:202). The Karnak List included a small number of rulers in genealogical and not chronological order which would not be of much assistance in building a reliable chronology of ancient Egyptian history (Kitchen 1991:202). Seti I recorded a similar list on the walls of his temple at Abydos (Kitchen 1991:202). His son, Ramesses II also left a similar list in Abydos (Kitchen 1991:202). Seventy kings were recorded in the lists of Seti I and Ramesses II and were arranged chronologically, but certain kings were intentionally omitted from these lists such as Queen Hatshepsut and King Akhenaten, in addition to the kings who ruled during the First and Second Intermediate Periods (Kitchen 1991:202).

A similar list, discovered on the walls of a private tomb at Saqqara, dates back to the reign of Ramesses II (Kitchen 1991:202). These lists do not provide us with information regarding the length of the reign of each king unlike the Turin List which is a document composed during the reign of Ramesses II (Kitchen 1991:202). None of the lists mention the exact dates when the kings ruled (Kitchen 1991:202).

Another important source of information is the Palermo Stone which associates each king with the important events that took place during his reign (Kitchen 1991:202). Fragments of this stone are housed in different museums and many parts are missing but the surviving parts provide chronological information from the Archaic Period till the middle of the Old Kingdom (Kitchen 1991:202).

2.1.4 Artefacts and recent excavations as sources of history:

More recently, different and more scientific methods of confirming chronological information and dating are used by Egyptologists (Shaw 2000:2). In 1899, Flinders Petrie first introduced the “sequence dating” as an essential excavation technique on excavating Diospolis Parva (Shaw 2000:2, Thomas 2012: Pers. Com). For example, the stratigraphic data from the site of El-Hemamiyeh which was excavated by Gertrude Caton Thompson provided precise information regarding the sequence of the different pre-dynastic cultures (Kitchen 1991:203, Thomas 2012: Pers. Com). Detailed studies of the material and design of one type of artefact and its development throughout the Egyptian history or part of it, are also used as a dating technique, such as the study of the coffins during the Middle Kingdom by Harco Willems (Shaw 2000:2) and the study of the *21st Dynasty coffins from Thebes, Chronological and Typological Studies* by Andrzej Niwiński (1988).

Artefacts inscribed with genealogical information, such as coffins and funerary objects can also provide valuable chronological information, especially when the ruling king is mentioned (Kitchen 1991:203). Objects such as the Donation and the Apis bull stelae are major sources of information, especially for the history of the Third Intermediate Period.

During many centuries, Egypt formed relations with kingdoms in the Near East through trade or expanding military activities. Comparing documents from foreign cultures that date certain events and synchronising these events with the Egyptian records can also provide more accurate dates for the kings who ruled during these times (Kitchen 1991:203). Scientific techniques such as Radiocarbon dating and dendrochronology or tree-ring dating can also provide a range of years important for dating artefacts which in turn can produce a more precise chronology of Egyptian history (Shaw 2000:2). Astronomical data were also considered when studying the historical events. For example, the eclipse that took place in 610 BC and was recorded in a demotic papyrus provides the historians with an exact date for the death of Psamtek I (Kitchen 1991:204).

All the above mentioned sources of information about Egyptian history are used by historians to form a reliable structure of each dynasty which is not an easy task as sometimes the information does not match, especially during periods of co regencies and Intermediate Periods when more than one king was ruling during the same period in different part of the

country, as in the 21st Dynasty (Shaw 2000:10). When two different sources provide controversial information it is important to evaluate the sources according to many criteria; one important consideration is how many years the source was compiled after the event in question (Jansen-Winkel 2006:219).

2.2 The Third Intermediate Period:

2.2.1 Introduction:

The Third Intermediate Period (c.1076 - c.723 BC) has been considered as a unique chapter of ancient Egyptian history (Taylor 2000:330). Although the term “Intermediate” is used to describe the political decline that took place during this period, it does not reflect the cultural development that continued under individual district administration (Taylor 2000:368). Kitchen (1986:xi) who published an extensive study of this historical period suggested that a more suitable term for this period would be “*Post- Imperial epoch*”, rather than being categorised with the First or Second Intermediate Period which were characterised by chaos and disorder. Other scholars suggested other names such as the “late New Kingdom” and the “Libyan Period” (Leahy 1985:53). It is interesting to note that Kitchen’s or Leahy’s suggestions, although more accurate, have not been widely used by scholars and the term “Third Intermediate Period” is still highly featured in studies and publications.

Modern historians mention different dates for the beginning of this period. Kitchen believes that c1069 BC, the year that Smendes I ascended the throne, marks the start of the 21st Dynasty and the Third Intermediate Period (Kitchen 1986:465), while a more recent study by Hornung *et al* (2006:493) mentioned the year 1076 BC as the beginning of the 21st Dynasty and the Third Intermediate Period. The same problem applies to the date that marks the end of this period as well. Kitchen suggests that the end of the 25th Dynasty and the Third Intermediate Period was c. 664 BC, marked by the end of Taharqa’s reign, while Hornung *et al* 2006 suggest that this should be c. 723 BC, marked by the end of the 24th Dynasty. The 25th Dynasty belongs to the Late Period according to Hornung *et al* (2006).

During the four centuries that followed the 20th Dynasty, the last dynasty of the New Kingdom, five dynasties ruled Egypt (21st -25th Dynasty) (Shaw & Nicholson 1995:288). Throughout the 21st Dynasty, Upper Egypt was under the control of the High Priests of Amun

who ruled from Thebes and extended their territories to include, in addition to the south, more than two thirds of the north (i.e. Lower Egypt), while the remaining part of the north was ruled from Tanis by the successors of the 20th Dynasty kings (Shaw & Nicholson 1995:288; Dodson & Hilton 2004:196). There is no evidence of any conflict between the north and the south during this dynasty (Dodson & Hilton 2004:196).

The historical period which extended from the 21st Dynasty to the 24th Dynasty is known as the Libyan Period because of the Libyan background of the kings (Taylor 2000:338). On the other hand, the 25th Dynasty is known as the Kushite Period as Egypt was ruled by kings who had Kushite ancestry (Taylor 2000:368). Meanwhile, Kitchen rejects the term Kushite, describing it as “*biblical*” and suggests the use of “Nubian” instead as it accurately describes the origin of the rulers of this dynasty (Kitchen 1986:xii).

At the end of this dynasty, Egypt was united again under the rule of Psamtik I, who was the founder of the 26th Dynasty (Taylor 2000:368). As evident from the above, Egyptologists do not agree on names and terms, let alone the chronology of the period. On the other hand, archaeological excavations at related sites such as Tanis and Gebel Barkal are shedding more light on this controversial historical period (Kitchen 1986:xii).

2.3 The end of the New Kingdom:

During the reign of the powerful kings of the New Kingdom, a successful system of interior administration was developed (Kitchen 1986:243). This system divided Egypt geographically into three main regions: the Delta, Upper Egypt, and Nubia which had its viceroys with titles such as “King’s son” and “Overseer of the Southern Lands” (Kitchen 1986:243; Reisner 1920:28). The division was mainly to facilitate the administrative affairs of each region while the army remained under the full centralized power of the king. This same system which hugely supported the powerful kings of the New Kingdom played a significant role in the political decline towards the end of this period (Kitchen 1986:243). As soon as less powerful rulers ascended the throne and the decentralization of the army occurred, Egypt (which was already administratively divided) was not united in the usual manner under one king (Kitchen 1986:3 & 243). The north was ruled by a series of kings from the northern capitals at Tanis, Memphis and Bubastis while the south was militarily and religiously governed by a lineage of High Priests of Amun from Thebes (Jansen-Winkel 2006:234).

2.4 The 21st Dynasty:

2.4.1 Summary of the Chronology of this dynasty:

Total of 126-128 years (Jansen-Winkel 2006:231).

The different genealogical outlines of this dynasty are provided by Kitchen (1986:473, 474 and 475).

Dynasty 21: ca.1076-944

2.4.2 List of kings who ruled from the north (Lower Egypt) ¹⁰:

Smendes ca.1076-1052 (Contemporary with Herihor according to the Tale of Wenamun, a hieratic papyrus now at the Pushkin Museum, Moscow (Shaw & Nicholson 1995:125) but originally discovered at El Hiba, the northern outpost of Theban territory (Egberts 1991:57). The text mainly describes an expedition sent by Herihor to Byblos to bring wood to build a new sacred boat to be used during the Opet festival of Amun (Jansen-Winkel 2006:218, Taylor 2000:331, Kitchen 1986:248,251). Wenamun probably travelled from El Hiba to Tanis before he was allowed by Smendes and his wife, Tentamun, to depart for Byblos (Egberts 1991:59). It is not clear if Smendes was Egyptian or not but it is known that he was father-in-law to Pinudjem I (Jansen-Winkel 2006:225, Taylor 2000:331). It has also been suggested by Wente that Smendes was the son of Herihor (Kitchen 1986:250). He is considered to be the founder of the dynasty in the north and he ruled from Pi-Ramesse and Tanis (Taylor 2000:331, Kitchen 1986:250). His marriage to Tentamun, who was a Ramesside princess, probably assisted to some extent his claim to the throne in the north (Taylor 2000:331). Niwiński suggests

¹⁰ (*Chronology of the 21st Dynasty based on Hornung et al 2006:493*)

that Tentamun was the wife of Ramesses XI and was appointed by Smendes to be the “*Chief of the Harim of Amun at Tanis*” (Niwiński1979:50).

Psusennes I	ca.1051-1006 (additional title as HP). He is the son of Pinudjem I (Jansen-Winkel 2006:225).
Amenemnisut	ca.1005-1002 (Manetho gave him this position while the Berlin genealogy mentioned that he ruled before Psusennes I (Jansen-Winkel 2006:219). Taylor (2000:333) supports the Berlin genealogy and that Smendes was succeeded by Amenemnisut.
Amenemope	ca.1002-993 (additional title as HP). No family relations with the HP at Thebes (Jansen-Winkel 2006:230).
Osorkon (the Elder)	992-987 (Osochor in Manetho’s list) start of a new family (son of Shoshenq A, the Libyan Meshwesh chief, and uncle of Shoshenq I)
Siamun	986-ca. 968 [identified with Psinaches in Manetho’s list even though the name and length of reign do not match up, but generally accepted by Egyptologists (Jansen-Winkel 2006:220)].
Psusennes II	ca. 968-944 The last king of this dynasty and also identified as the High Priest of Amun, Psusennes III (Jansen-Winkel 2006:221). A graffito from the temple of Abydos mentions all his titles including a combination of military and priestly duties (Jansen-Winkel 2006:222). He was probably buried in Tanis, then reburied in the vestibule of the tomb of Psusennes I (Jansen-Winkel 2006:223).

2.4.3 List of army commanders and High Priests of Amun (who ruled Upper Egypt)¹¹:

(Names of the High Priests of Amun were found inscribed on the mummy wrappings of the kings and queens who were reburied during this dynasty, except for Payankh as this project must have started after his period in office (Jansen-Winkel 2006:226).

Payankh	High Priest of Amun during the reign of Ramesses XI. He fought against the Nubian invasion led by the Viceroy of Kush, Panehsy (Taylor 2000:331). He defeated the Nubian army and liberated the southern Egyptian towns but could not restore the Egyptian control over Nubia (Taylor 2000:331).
Herihor	Son-in-law (or father-in-law) of Payankh. He also may have succeeded Payankh by marrying his widow (Jansen-Winkel 2006:225). Recent studies are now in favour of placing Herihor as a successor to Payankh (Jansen-Winkel 2006:226). He held his position for probably around 6 to 8 years (Jansen-Winkel 2006:230). Kitchen (1986:253) suggested that some of Herihor's offspring had Libyan names which indicates that he was possibly married to a Libyan wife (Leahy 1985:55).
Pinudjem I	Son of Paynkh and father of Masaharta, Djed-Khons-ef-ankh and Menkheperre {his name was sometimes written in a cartouche (Jansen-Winkel 2006:221)}. He is also father of Psusennes I and son-in-law of Smendes I (Niwinski 1979:50).
Masaharta	Son of Pinudjem I. Probably he was High Priest during his father's time in office (Jansen-Winkel 2006:231)
Djed-Khons-ef-ankh	High Priest, son of Pinudjem I. The name Djed-Khons-ef-ankh was only found on his son's coffin which is currently missing (Jansen-Winkel 2006:225) and was reported by Cecil Torr (Kitchen 1986

¹¹ (Chronology of the High Priests in Thebes during the 21st Dynasty from Kitchen 1986 and Jansen-Winkel 2006).

:424). The inscription on the coffin mentioned that the deceased is “son of the first priest of Amun, Djed-Khons-ef-anekh, son of the lord of two lands, Panedjem meri Amen (in cartouche), first priest of Amun” (Kitchen1986:424) .

Menkheperre	High Priest, son of Pinudjem I (name appears in cartouche on mummy shrouds and braces from the second cache tomb of Bab el Gusus, burials A11 and 64 (Jansen-Winkeln 2006:221). A new dating system was introduced just after he became a High Priest in Year 25 of the reign of his father, Pinudjem I (Jansen-Winkeln 2006:230). He was probably a contemporary with King Amenemope at Tanis (Jansen-Winkeln 2006:230). Taylor (2000:334) mentioned that he ruled the south while Psusennes I ruled the north.
Smendes II	High Priest, son of Menkheperre, who ruled for a short time maybe in co-regency with his father Menkheperre or as his successor (Jansen-Winkeln 2006:224).
Pinudjem II	High Priest, son of Menkheperre {never used any royal attributes and name was not written in a cartouche (Jansen-Winkeln 2006:221).
Psusennes III	High Priest, son of Pinudjem II (identified as King Psusennes II c. 968-944 who first had the position of High Priest and then ascended the throne following Siamun, keeping his position as High Priest (Jansen-Winkeln 2006:221). Evidence is a military title that was only found in connection with Theban High Priests and military commanders. His daughter, Maatkare, was the mother of Shoshenq II).

Little is known about the genealogical connections between the Tanite Kings and not about the origin of a number of them (Jansen-Winkeln 2006:224). Alternatively, the priests of Amun who ruled from the south are known to have belonged to the same family (Jansen-Winkeln 2006:224). On one occasion, two members of the Theban family ruled the north and the south in unison: the sons of Pinudjem I ruled the north (Psusennes I) and the south (Menkheperre) (Taylor 2000:333-334).

It is clear from the historical studies of the Third intermediate Period that a detailed chronology of the 21st dynasty, supported by physical and documented evidence and accepted by all scholars, is still to be achieved.

2.5 Historical resources:

The information we have about this dynasty, still described as “obscure”, comes from different archaeological sources such as the inscriptions found on mummy shrouds and mummy braces from the first and second Deir el Bahari caches (Kitchen 1986:3-4).

2.5.1 The First Cache at Deir el Bahari:

Maspero, Daressy, Breasted and Černý worked on the translation of the hieratic inscriptions on the walls and the docketts found on the coffins discovered in the cachet at Deir el Bahari (Černý 1946:24-30). Černý (1946:25-6) examined the hieratic inscriptions on the walls of the cachet in 1938 and found that the inscription reported by Maspero on one of the walls had totally disappeared but it has been preserved in a facsimile that Maspero made just after it was discovered (Černý 1946:25-6).

It is clear how the mummies provided vital information that was essential to establish a coherent chronology of this “obscure” period. As this history has been formed largely by a number of archaeological discoveries and historical ancient and classical texts, any new discoveries would reshape, enhance, add to or confirm the current understanding of this period.

2.6 Social, Religious and Cultural aspects of the 21st Dynasty:

During the 21st Dynasty, Egypt was ruled from two major cities, Tanis in the north (Lower Egypt) and Thebes in the south (Upper Egypt) (Taylor 2000:331). It has been established by historians that Smendes was the first king of this dynasty. He possibly claimed the throne in the north by marrying Tentamun, a Ramesside princess (Taylor 2000:331). As for the south, the army general, Payankh was in control as the High Priest of Amun (Taylor 2000:331). Towards the beginning of the 21st dynasty, General Payankh had to defend the southern Egyptian towns against the Nubian invasion led by Panehsy, the Viceroy of Kush (Taylor








2000:331). He managed to force the Nubian army back to Nubia but he failed to place it again under full Egyptian control (Taylor 2000:331). This did not just affect the image of Egypt in the whole region as a great power but also undermined the Egyptian economy. Egypt lost its main source of gold from the Nubian mines as well as the huge trading profits from the African products (Taylor 2000:331). This image was mirrored in the north as news of a marriage between an Egyptian princess and a king from Israel was documented. During periods of power and military domination foreign princesses were known to be members of the royal harem but female members of the Egyptian royal family were not allowed to marry outside Egypt (Taylor 2000:333).

The city of *Teudjoi* or El Hiba (Tayu-djayet (*t3yw-d3yt*), stood as the northern boundary of the Theban rulers and was fortified and protected by a great enclosure wall (Taylor 2000:333). Although recent excavations suggest that the city could have been established during the New Kingdom, its importance increased as a fortress during the Third Intermediate Period (Shaw & Nicholson 1995:127). The city was chosen for its superior location that controls the Nile passage to the south (Kitchen 1986:248). A reference to the city occurred in the account of Wenamun which suggests that the fortification could have been established as early as during the reign of Herihor (Kitchen 1986:248). The city possibly included a palace for the southern rulers and excavations have revealed evidence of Pinudjem I, Istemkheb (probably his wife) and his son Menkheperre within the enclosure wall (Shaw & Nicholson 1995:127; Kitchen 1986:61). Other fortifications were constructed by the army commanders and priests of Amun to protect their territories along the Nile (Taylor 2000:333). Sheshonq I constructed a temple dedicated to “*Amun great of roarings*” in the city (Shaw & Nicholson 1995:127).

The southern rulers of the 21st Dynasty turned their attention to the Valley of the Kings. They focused their attention on clearing all the New Kingdom royal tombs and had no intention of building any more there. This in turn instigated the dispersal of the large community of artisans and craftsmen who lived for decades in the village of Deir el Medina and were in charge of preparing the royal tombs in the Valley of the Kings (Taylor 2000:333).

The royal mummies were collected, rewrapped and enclosed in simple wooden coffins before they were deposited in caches (Taylor 2000:333).

2.7 Tanis:

Known now as San el Hagar, Tanis or Djanet {Dan.t    } (Gardiner 1933b:123) or    (Gardiner 1933b:126)} was established by the kings of the 21st Dynasty (Shaw & Nicholson 1995:282). Stone blocks from other monuments, mainly from the Ramesside capital, Pi-Ramesse, were used to build the royal tombs and the temple of Amun which was surrounded by a high mud brick wall constructed during the reign of Psusennes I (Shaw & Nicholson 1995:282). Archaeological excavations at the site, led by Mariette started as early as 1860, but the most remarkable discovery from the city are the tombs of the 21st and the 22nd Dynasty kings (Shaw & Nicholson 1995:282). In 1939, while excavating at the south west corner of the temple, within the huge enclosure wall that was built during the reign of Psusennes I, Montet discovered six royal underground tombs which contained the coffins and funerary artefacts belonging to Psusennes I, Amenemope, Osorkon II, Shoshenq III, Shoshenq II and Takelot II (Shaw & Nicholson 1995:282, Taylor 2000:333). One of the most remarkable artefacts that Montet discovered during this excavation is the silver coffin of Sheshonq (*HqA -xpr-Ra*), which was thought to belong to Sheshonq II (Shaw & Nicholson 1995:282, Jansen-Winkel 2006:235).

Evidence from other archaeological sites supports the fact that the king and the elite of the Third Intermediate Period preferred to build their tombs attached to the temples (Spencer 2007:49-50). Recent archaeological excavation reported the discovery of elite tombs attached to the temple of Thoth at El Ashmunein (Spencer 2007:49-50). Spencer suggested that these tombs could belong to the High Priests of Thoth or the local monarchs of the area such as Nimlot or Thotemhat (Spencer 2007:50). Thotemhat's name was found on a block statue in the Cairo Museum and on a bronze shrine at the British Museum (Spencer & Spencer 1986:198). Although likely to originate in Thebes, the inscriptions describe Thotemhat as lord of Hermopolis (Spencer & Spencer 1986:199). Spencer also suggests that he could have been a descendant of the 23rd dynasty kings (Spencer & Spencer 1986:199).

Although the excavations at Tanis provided important information regarding funerary practices during this period (Shaw & Nicholson 1995:283), they have not provided evidence of administrative or residential activities (Taylor 2000:333). On the other hand, archaeological evidence suggests that Memphis was the royal and political residence (Taylor

2000:333). Great construction activities took place within both cities during the 21st dynasty by the northern kings such as Psusennes I and Siamun (Taylor 2000:333).

2.8 The Libyan presence in the Delta:

Military campaigns against the two major Libyan tribes, the Meshwesh and the Libu, were led by Merenptah followed by Ramesses III during the New Kingdom in order to defend the Egyptian western borders (Taylor 2000:335). This resulted in the presence of a large number of Libyans, most of whom were originally captives or mercenaries in the Egyptian army, and their descendants who settled in the north of Egypt, not far from Cyrenaica, their land of origin (Taylor 2000:335). Some were given gifts of land as a reward for their bravery and for fighting alongside the Egyptian troops (David 1980:195).

Their power increased significantly especially during the First Intermediate Period, particularly with the lack of strong centralised government (Taylor 2000:335). Rulers with Libyan origins, evident from their names, such as Sheshonq and Osorkon, appear during this period not only as northern rulers but also in the south (Taylor 2000:335). It is difficult to ascertain the number of Libyan rulers and officials in charge of administration of the country at that point as many would have adopted Egyptian names and culture (Taylor 2000:335).

2.9 22nd Dynasty (943-c746 BC):

Not much change took place during the 22nd dynasty regarding the ruling of Egypt. The south was still ruled from Thebes and Herakleopolis by army commanders who would also have had the title High Priest of Amun (Jansen-Winkel 2006:234). The north was ruled from Tanis and Memphis by a number of kings. During the early years of the 22nd Dynasty, the northern kings were strong enough to assign the position of the High Priest of Amun to one of their sons, an arrangement which maintained a form of unity within the country (Jansen-Winkel 2006:234).

The Donation and the Serapeum Stelae are considered to be the main sources of historical information regarding the north during this dynasty, while information regarding the south can be deduced from the Nile level records, Prince Osorkon's archives, the records of the Karnak priests, and other inscribed objects from this period (Jansen-Winkel 2006:234).

The Donation Stelae were erected to document a gift from the king or a wealthy worshipper, usually of a piece of land in order that its revenue could be used to support the daily maintenance of a certain god in his temple (Schulman 1966:33). The texts inscribed on these stelae provide important chronological information regarding the donor as well as the contemporary king (Schulman 1966:33). This type of stela flourished during the Libyan Period as most of the surviving examples date back to this period or are from an Egyptian region with strong Libyan influence (Schulman 1966:34).

The inscriptions on the Serapeum Stelae would mention the exact date of the burial of an Apis bull or the introduction of a new Apis bull. This information would include the name of the king and the year of his reign (Jansen-Winkel 2006:235).

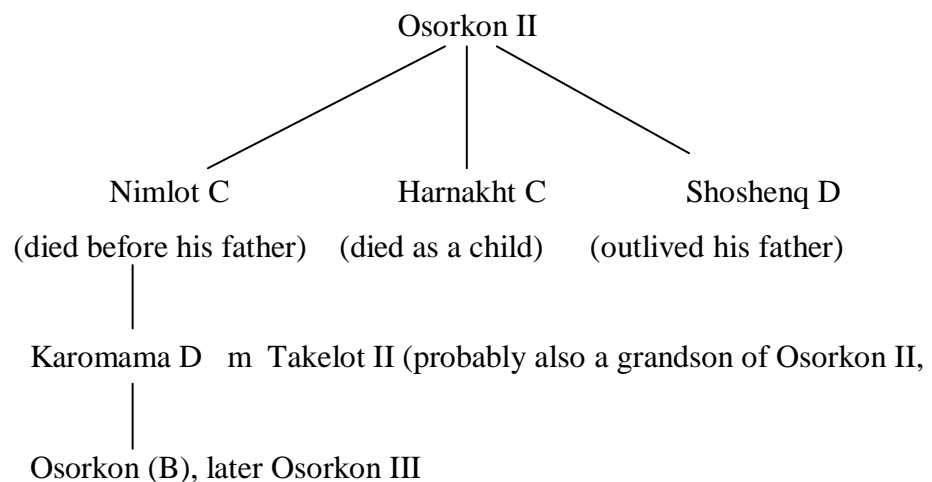
The inundation levels of the Nile were recorded on a wall at the quayside at the great Temple of Amun at Karnak. Each inscription refers to the Nile level in a certain year and provides information such as the name and titles of the ruler(s) of the country during this specific year (Broekman 2002:163). The 45 short inscriptions which were first published and translated briefly by Legrain in 1896 extend from Year 6 of the reign of Shoshenq I (943-923BC) to Year 19 of the reign of Psametik I (664-610 BC) (Beckerath 1966:44-48).

Prince Osorkon's archives or "*The Chronicles of Prince Osorkon*" refer to the High Priest Osorkon (later Osorkon III), son of Takelot II (Jansen-Winkel 2006:242). These archives, which were inscribed on the walls of the Bubastis Gate in the Temple of Amun at Karnak, record episodes of the civil war provoked by Osorkon appointing himself as the High Priest of Amun in Thebes (Taylor 2000:337).

The records or annals of the priests of Amun are inscriptions found at the Temple of Karnak in the Festival Hall of Tuthmosis III (Young 1963:100). These inscriptions provide detailed accounts of the induction of each priest, providing exact dates and the ruling king at that time (Young 1963:100). They are an important source of genealogical information as the priestly positions were hereditary during this historical period (Young 1963:100). The annals consist of forty-six documents which were copied by Legrain for publication in 1905 (Schulman 1994:59). These copies were lost for a long time before they were found in a storeroom at

Karnak and were thoroughly studied by Kruchten in preparation for publication¹² in 1989 (Schulman 1994:59). Kruchten studied and analysed the texts from Legrain's squeezes as most of the original inscriptions had been lost except for a few pieces in the collection of the Egyptian Museum, Cairo and the Fitzwilliam Museum, Cambridge (E.SS.67-E.SS.68) (Kitchen 1993:308). Kruchten's study and translation of the texts has provided vital and reliable information regarding the Third Intermediate Period.

It seems that Takelot F, who was a grandson of Osorkon II and a High Priest of Amun during his reign, became Takelot II (Jansen-Winkel 2006:240, 242). It has been also noted that the records from the north were mainly written in the Demotic script while the southern records were in Hieratic (Jansen-Winkel 2006:234).



(According to *The Chronicles of Prince Osorkon* from Jansen-Winkel 2006 and Aston 1989)

2.10 Chronology of the 22nd Dynasty:

2.10.1 Northern Rulers:

Shoshenq I (943-923 BC) Sesonchis, according to Manetho, ruled for 21 years. Jansen-Winkel disagrees with Dodson who suggests that there was a co-regency between Psusennes II and Shoshenq I (Jansen-

¹² Kruchten (1989) *Les annales des pretres de Karnak (XXI-XXIII^{es} Dynasties) et autres textes contemporains relatifs a l'initiation des pretres d'Amon.*, avec un chapitre archeologique par Thierry Zimmer. Orientalia Lovaniensia Analecta. Louvain, Peeters.

Winkeln 2006:237). He first ruled Egypt as the Chief of the Meshwesh until the 5th year of his reign when he was represented with full Egyptian regalia and names as attested on the inscription on the Dakhla Stela translated by Gardiner (Baer 1973:4, Gardiner 1933a:21). The sunken relief on the Stela of Gebel Silsila mentions that during the 21st year of his reign, Shoshenq commissioned a pylon and a hypostyle hall with large number of statues to be constructed at the Temple of Amun at Karnak (Camino 1952:47,59). Shoshenq is famous for the construction of the Bubastis Gate at the Temple of Amun at Karnak in addition to his reliefs in the Temple of El Hibah (Camino 1952:47).

Osorkon I (922- c888 BC): Osorthon ruled for 15 years according to Manetho following Africanus, but an inscription found on a mummy shroud mentions Year 33 of his reign (Jansen-Winkeln 2006:238). He is a son of Shoshenq I and the first Third Intermediate Period king who is documented at Bubastis (Jansen-Winkeln 2006:237) where he added a hypostyle hall to the Temple of Bastet as well as a new court to commemorate his *heb sed* celebrations (Shaw & Nicholson 1995:50).

Three kings ruled for 25 years between Osorkon I and Takelot I according to Manetho (Jansen-Winkeln 2006:235). Two of them may be:

Shoshenq (*HqA -xpr-Ra*) He possibly ruled after his brother Osorkon I. His mummy was found with other Third Intermediate Period mummies in the vestibule of the tomb of Psusennes I at Tanis. Examination of the mummy concluded that his age at death was +50 years old. Objects belonging to earlier kings and members of his family, such as Shoshenq I, were found with him (Jansen-Winkeln 2006:237). Montet suggested that this king ruled between Takelot I and Osorkon II (Baer 1973:6).

- Shoshenq IIb(*Twt-xpr-Ra*) His name was inscribed on an ostrakon discovered in 1897 in Abydos (Lange 2010:19) and on another limestone relief from Bubastis discovered in 1994 (Jansen-Winkel 2006:237, Lange 2010:19). It seems that Shoshenq IIb commissioned some construction work at the Temple of Bastet as Naville also discovered a relief with the same name on a stone fragment from the same site (Lange 2010:20). During recent excavations conducted by the German Egyptian mission at the Temple of Bastet, limestone and faience shabti fragments inscribed with Shoshenq's name were found (Lang 2010:20). Although it is not clear which Shoshenq the inscriptions refer to, more archaeological excavations at the site might give more clues to the identity of this king (Lang 2010:20).
- Takelot I (887-c 874 BC): Takelotis ruled for 13 years according to Manetho following Africanus. He was the father of Osorkon II (Jansen-Winkel 2006:236). The Nile inundation-level records mention Year 5 of his reign (Jansen-Winkel 2006:239). Recent research assigns 15 years to the reign of Takelot combined with his two predecessors (Jansen-Winkel 2006:239). He was followed by three more kings who ruled for 42 years according to Manetho.
- Shoshenq II (873 BC): He probably did not have an independent reign and ruled Upper Egypt as an army commander and High Priest of Amun during the reign of his father (Shoshenq I) (Jansen-Winkel 2006:238).
- Osorkon II (872-842 BC) Son of Takelot I (Jansen-Winkel 2006:236). It is not clear how long he ruled Egypt (Jansen-Winkel 2006:239). An inscription on a stela from the Serapeum refers to Year 23 of his reign when an Apis bull was buried (Jansen-Winkel 2006:239). The same stela mentions his son, Shoshenq D, as the Crown Prince (Jansen-Winkel 2006:239). An inscription in his tomb referred to him as the Crown Prince which suggests that he died before

he inherited the throne (Jansen-Winkel 2006:239). Therefore, Kitchen (1986:467) suggested that Osorkon II ruled for about 24 years. On the other hand, amulets found in his tomb refer to him as Shoshenq III and not the Crown Prince which rules out the suggestion that he died before his father Osorkon II (Jansen-Winkel 2006:240). Aston (1989:139) disagrees with Kitchen and suggests a reign of around 45 years for Osorkon II based on genealogical data related to the High Priests of Amun in Thebes which would imply the highly unlikely conclusion that Osorkon II outlived three of his sons (Nimlot C, Shoshenq D and Harnakht C). (Jansen-Winkel 2006:240). During Osorkon's II reign, three High Priests of Amun were controlling the south, Nimlot C (his son who probably died during the reign of Osorkon II), Takelot F (his grandson and later Takelot II) and Harsiese B.

Broekman (2002:174) suggested, and Jansen-Winkel (2006:240) agrees, that the king mentioned in the Nile inundation level inscription number 14 refers to Osorkon II as he is the first king to use the name *Wsr mAat Ra*. The inscription refers to Year 29 of the reign of this king which supports a longer reign for Osorkon II (Jansen-Winkel 2006:241). If Osorkon ruled for 40 years as suggested by some Egyptologists, it is hard to dismiss the fact that his last 10 years on the throne were not documented on any monument (Jansen-Winkel 2006:241).

The end of unified Egypt during the 22nd Dynasty and the start of parallel rulers, kings in the north and army commanders and High Priests of Amun in the south.

2.10.2 Northern Kings:

Shoshenq III (841-803 BC) (*PA dj-Ast*) He ascended the throne after Osorkon II and ruled the north for 39 years while Takelot II ruled the south. The reign of Shoshenq III was used to date events starting from Year 22 Jansen-Winkel 2006:242). He had a strong relationship to Osorkon II as a great grandson of Osorkon II and his mother, *Tz-BAstt-prt*, was a daughter of Osorkon II; Shoshenq III would have ascended the throne in the north with no trouble as a legitimate successor (Jansen-Winkel 2006:244). His construction projects included adding a gateway to the Temple of Amun at Tanis reusing stone blocks from the Delta especially from the city of Pi-Ramesse such as the granite blocks cut from statues of Ramesses II (Kitchen 1991:203; Brand 2010:5) (Fig:2.1).

Shoshenq IIIa (?- 790 BC) (*HD-xpr-Ra*) His mummy was found in the tomb of Shoshenq III. A Donation Stela dating to Year 10 of his reign was discovered. There is no firm evidence regarding the length of his reign but it is possible that he ruled for 10 to 13 years (Jansen-Winkel 2006:244). He is also known as Shoshenq IV and Ib.

Pami (789-784BC): His name means “The cat” (Bickel *et al* 1998:40). He ruled for 6 years as has been recorded in the inscription of his annals in Heliopolis which was reused and later found as part of a medieval Islamic fortification in Old Cairo called Bab El Nasr (Bickel *et al* 1998:31) (Fig:2.2). Few monuments were constructed during his relatively short reign (Jansen-Winkel 2006:244). It is possible that he was succeeded by one of his sons for a short period before Shoshenq V ascended the throne (Jansen-Winkel 2006:245).



Fig:2.1. Red granite block originally belonging to a statue of Ramesses II and reused by Shoshenq III to construct his gateway at the Temple of Tanis (from Brand 2010:5).

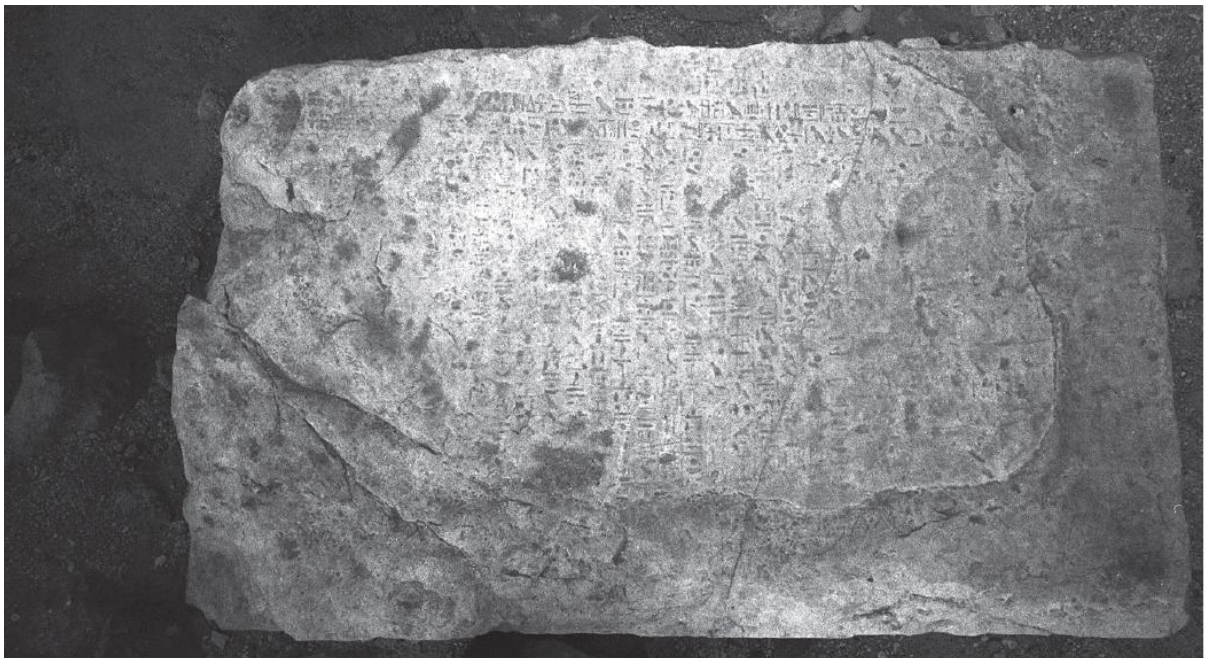


Fig:2.2. The limestone block with the inscription of the Annals of Pami in Heliopolis, 22 Dynasty (from Bickel *et al* 1998:33).

Shoshenq V (783- c746 BC): Son of Pami. He ruled after his father for around 38 years as documented on a stela from Tell Farain (Jansen-Winkeln 2006:245). Evidence of his reign was found in Memphis, Buto, Tanis, Bubastis, Kom Firin and other locations in the Delta but he was not mentioned on Piye's Victory Stela which indicates that he possibly died before the Nubian invasion (Jansen-Winkeln 2006:245-6). He was probably succeeded on the throne by Petubaste who ruled for a short period, followed by Osorkon IV, but the lack of documents does not provide more reliable information (Jansen-Winkeln 2006:246). The death of Shoshenq V marks the end of the 22nd Dynasty in the north and both Petubaste and Osorkon IV are considered to be rulers of the 23rd dynasty in the north (Jansen-Winkeln 2006:247).

This chronology is supported by genealogical information inscribed on the Serapeum stela of Pasenhor who lived at Herakleopolis during the reign of king Sheshonq V (Jansen-Winkeln 2006:235, Leahy 1985:55).

2.10.3 High Priests of Amun, army commanders and rival kings in control of the south (also known as the 23rd Dynasty):

Takelot II (845-821 BC) He ruled for 25 years (Jansen-Winkeln 2006:248). Events were first dated according to the reign of Takelot II as demonstrated in the Chronicle of Prince Osorkon. This continued until Year 24 of Takelot's reign when Prince Osorkon started using the years of Shoshenq III's reign for dating the different events such as donations (Jansen-Winkeln 2006:242). There are few inscriptions from Thebes that mention Takelot II (Jansen-Winkeln 2006:242). Kitchen disagrees with Aston (1989:139) and Beckerath (1997:94), suggesting that there is no evidence to confirm that Takelot II, a Libyan king, ruled from Thebes (Kitchen 1999:247).

There is evidence that Harsiese A ruled Thebes as a king before Takelot II (Jansen-Winkel 2006:247, Taylor 2000:337). Harsiese was buried at the temple of Medinet Habu in an anthropoid coffin with falcon head similar to the coffins of the Tanite kings (Taylor 2000:337, Spencer 2007:50). His name in a cartouche was found on a fragment of a wooden coffin discovered at Abydos which belonged to his daughter (Taylor 1988:230). The Chronicles of Osorkon also mention a civil war that took place during the reign of Takelot II which allowed Petubastis to become a rival king (Jansen-Winkel 2006:248).

Iuput I (820-809 BC) He succeeded Takelot II as a Theban monarch and ruled in parallel to Petubaste I, the rival king, and Shoshenq III in the north (Jansen-Winkel 2006:250). He ruled for 17 years (Jansen-Winkel 2006:252).

Osorkon III (825-773 BC) He was the son of Takelot II and father of Takelot III and Rudamun (Jansen-Winkel 2006:248). Osorkon III used the title of General and High Priest of Amun and is famous for the detailed accounts which are known as the Chronicles of Prince Osorkon (Jansen-Winkel 2006:249). He occupied the position of High Priest of Amun since the start of civil war during year 11 of Takelot II and continued throughout the reign of Iuput I (Jansen-Winkel 2006:252). He ascended the throne after Iuput I and ruled the south with no parallel rival kings (Jansen-Winkel 2006:252). He ruled for 28 years and formed a co-regency with his son, Takelot III, after more than two decades on the throne (Jansen-Winkel 2006:252). He ruled the south parallel to Shoshenq IIIa, Pami and Shoshenq V in the north (Jansen-Winkel 2006:254). A stela and other stone fragment with relief of his name were found by the British Museum excavation team at El Ashmunein (Spencer 2007:49). Kitchen (1999:247) disagrees with identifying Osorkon III with the Prince Osorkon, son of Takelot, claiming that the Thebans

would have never tolerated a Libyan king to rule the south (Kitchen 1999:247).

Takelot III (780BC± 20) Son of Osorkon III and his coregent towards the end of his reign (probably during year 24) (Jansen-Winkel 2006:254). He continued to rule with Osorkon III for 7 years before he died and Takelot III became the sole ruler (Jansen-Winkel 2006:254).

2.10.4 The Southern Rival Kings:

1-Petubaste I (834-812 BC) Petubaste I (or Pedubastis) ruled for 23 years parallel to Takelot II, Iuput I (Jansen-Winkel 2006:250). He was mainly documented in Upper Egypt (Jansen-Winkel 2006:248). Evidence from the records of the Nile levels suggests that he ruled from Thebes parallel to Shoshenq III in the north and Takelot II and Iuput I in the south (Jansen-Winkel 2006:248). He led a civil war supported by Harsiese B, the High Priest of Amun during Year 11 of Takelot II's reign but the records do not mention them until after a second revolution four years later (Jansen-Winkel 2006:249). His claim to the throne was probably based on his family connections with the rulers of the 22nd Dynasty (Taylor 2000:337). An elaborately decorated inlaid bronze statue that belonged to Petubaste and is now in the Calouste Gulbenkian Museum is a testimony to the remarkable standard of manufacturing bronze statues during the Third Intermediate Period (Hill & Schorsch 2005:163-195)(Fig:2.3). Although the provenance of this statue is unknown as it was purchased by Stroganoff around 1880, Maspero (1887:291-292) and then Petrie (1905:324) mentioned that the statue was found in Tanis which led many historians such as Kitchen to associate Petubaste with the north (Hill & Schorsch 2005:163-166).



Fig:2.3. Bronze torso of King Petubaste I in Calouste Gulbenkian Museum, Lisbon (from Hill & Schorsch 2005:19).

Schulman (1966:37-38) suggested that two kings with the name, Petubaste, ruled the north and the south during different periods which resolved the historical problem of trying to fit the northern Petubaste in the south. This suggestion was previously mentioned by Gauthier who proposed the probability of three kings with the same name (Schulman 1966:37). Documents also suggest that Harsiese B, who was a High Priest during the reign of Osorkon II, occupied the same position during Year 9 of Takelot II and later continued with the same position during Petubaste I's reign (Jansen-Winkel 2006:250). Harsiese B was succeeded by Takelot E as the High Priest of Amun during the last year of Petubaste I's reign (Jansen-Winkel 2006:251)

2- Shoshenq IV

His name was recorded on an inscription of the Nile level as a ruler of the south and Takelot E was High Priest of Amun during his reign (Jansen-Winkel 2006:249). He succeeded Petubaste I and ruled parallel to Iuput I in the south and Shoshenq II in the north (Jansen-Winkel 2006:250). It is not certain when he ascended the throne but he was the last of the rival kings in Thebes (Jansen-Winkel 2006:252).

Rudamun,

Son of Osorkon III and brother of Takelot III (Jansen-Winkel 2006:248, 255), he was also the father-in-law of Peftjauawybast, the ruler of Herakleopolis (Jansen-Winkel 2006:248). There is no evidence to indicate when he ruled but most probably he succeeded his brother Takelot III on the throne. (Jansen-Winkel 2006:255, 256). Some evidence suggests that he ruled as a king in Hermopolis during the reign of his brother Takelot III (Jansen-Winkel 2006:256).

Iny

His name was found in documents from Thebes and Abydos (Jansen-Winkel 2006:255). It is not sure how long his reign

lasted but one inscription refers to Year 5 of his reign (Jansen-Winkel 2006:255).

Iuput II

Only documented in the north (Jansen-Winkel 2006:248), his name was mentioned in the Victory Stela of Piye as the ruler of the Delta cities of Ta-Remu and Ta-anu (Spencer & Spencer 1986:200, Muhs 1998:223) (Fig:2.4). Spencer and Spencer (1986:200) suggested that Iuput II should be placed at the end of the 22nd Dynasty, based on the lack of any evidence to connect him with the 23rd Dynasty as well as the fact that the monarchs of that dynasty ruled from Thebes and that all the evidence regarding Iuput II came from the north. Muhs (1998:223) agrees with Spencer and Spencer regarding placing Iuput II at the end of the 22nd Dynasty as a successor of Shoshenq V but suggested that he ruled from Thebes, based on his name “son of Bastet”. Iuput II (Fig:2.5) was recognised by the rulers of Mendes and possibly ruled during the reign of Osorkon IV (Spencer & Spencer 1986:200). A stela from Mendes records Year 21 of his reign (Spencer & Spencer 1986:200; Muhs 1998:223).

2.11 The 23rd Dynasty:

2.11.1 Northern Kings:

Petubaste II (?), Osorkon IV (c730 BC)

The death of Shoshenq V marked the end of the 22nd Dynasty in the north and both Petubaste II who probably ruled for a very short period and Osorkon IV are considered to belong to the 23rd northern dynasty (Jansen-Winkel 2006:246). The name and titles of Petubaste II were found on objects from northern cities such as Memphis



Fig:2.4. Upper right side of the Stela of Piye showing the subdued kings, Osorkon IV, Iuput II and Peftjauwybast (from Leahy 1991:Pl XXVI,1).

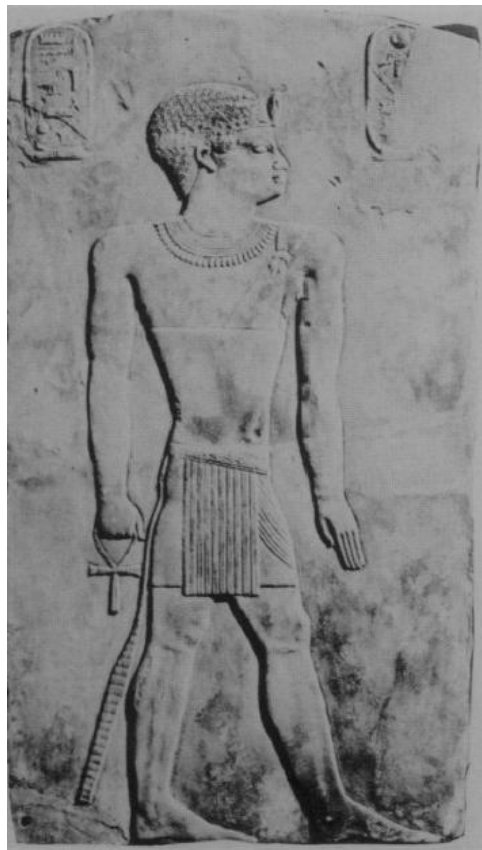


Fig:2.5. Iuput II wearing the cap crown on a faience Plaque at the Brooklyn Museum, end of 22nd Dynasty (from Leahy 1991:Pl XXVII,2).

and Tanis where he was regarded as a king (Jansen-Winkel 2006:247, Taylor 2000:354). Osorkon IV was mentioned in Piye's Victory Stela and continued to be in charge of parts of the north including Bubastis and Tanis until around 715 BC (Jansen-Winkel 2006:247). There is a possibility that he is the king identified as Shilkanni in the Annals of Sargon II (Jansen-Winkel 2006:260).

2.11.2 The 24th Dynasty:

Tefnakhte (736-729 BC)

His name and titles appear on a number of stelae. His titles were the "Great Chief of the Ma and the Commander of the Libu", and then progressed further to "The Great Prince of the Entire Land" towards the end of Shoshenq V's reign (Jansen-Winkel 2006:246,263). He ruled Memphis, Buto, Kom Firin and mainly the western Delta (Jansen-Winkel 2006:246) before he expanded his territory to include the northern cities of Upper Egypt (Taylor 2000:337). His military campaign was blamed for provoking the Nubian invasion led by Piye around 733BC. Tefnakhte continued to rule the north following Piye's campaign and later ruled as king (Taylor 2000:338).

Bocchoris (728-723 BC)

(or Bakenrenef) According to Manetho, following Africanus, Bocchoris ruled for six years (Jansen-Winkel 2006:262). A stela refers to the burial of an Apis bull during Year 6 of his reign (Jansen-Winkel 2006:261). Another inscription from the Serapeum related to the burial of the bull identifies the same year with the second year of Shabaka's reign (Jansen-

Winkeln 2006:261). He ruled from Sais but his power extended over Lower Egypt and south along the Nile as far as Herakleopolis (Taylor 2000:338). Manetho also mentioned that Bocchoris was killed by Shabaka who led the second Nubian invasion around 716 BC (Jansen-Winkeln 2006:262, Taylor 2000:338). Redford (1985:6) identifies him as the king whom Yamani, the Ashdod leader, asked for military support against the Assyrian king Sargon.

2.11.3 The 25th Dynasty:

Piye (753-723 BC)

Son of Kashta (Taylor 2000:337), he ruled for about 31 years most of which he spent in Nubia (Jansen-Winkeln 2006:262, Taylor 2000:353). A dated inscription on a mummy shroud in the British Museum refers to Year 20 of his reign but Redford suggests that the scribe left enough space to add two more signs which would read Year 40 (Redford 1985:11). Green (1993:101) suggests that Piye was the biblical “King So” whom Hosea, the king of Samaria, asked for his military support. Around 733 BC, he led an army to invade Egypt and he succeeded in subduing the northern rulers before he returned to Nubia, leaving Egypt to be governed with more or less the same political arrangements as before his campaign (Taylor 2000:337-338). He was buried at el Kurru in a tomb with a pyramid superstructure (Taylor 2000:354). His burial shows some strong Egyptian religious and cultural characteristics such as shabti figures mixed with unique Nubian traditions such as the burial of chariot horses (Taylor 2000:354). He was buried in a stone pyramid at the royal cemetery at El Kurru which was discovered in 1919 (Ikram & Dodson 1998:315).

Shabaka (722-707 BC)

He ruled for around 14 years (Jansen-Winkeln 2006:258). An inscription on a block statue at the British Museum records Year 15 of his reign (Jansen-Winkeln 2006:261). Around 716 BC, he led the second Nubian invasion, expanded his authority over the northern region and was recognised by the northern kings as an Egyptian pharaoh (Taylor 2000:338, 354). Redford (1985:7) suggests that Shabaka's campaign took place around 712 BC. Egypt was still far from being unified under one king at this stage as the government was still decentralised (Taylor 2000:354). He was probably a brother of Piye (Taylor 2000:355). His tomb was found in the Royal Cemetery at El Kurru in 1919 (Ikram & Dodson 1998:315).

Shebitku (706-690 BC)

He ruled for about 16 years as recorded in the annals of the Assyrian king Sargon II (Jansen-Winkeln 2006:258). His third year as a king is recorded on the Nile level number 33 (Jansen-Winkeln 2006:258). He was responsible for the extradition of Yamani to the Assyrians after he was granted asylum by Shabaka (Jansen-Winkeln 2006:259). He ruled from Nubia for the first three years of his reign before he moved to Egypt (Jansen-Winkeln 2006:259). Beckerath (2001:1) suggested that, according to the Sargon II text, Shebitku was appointed as the Viceroy of Kush during the reign of Shabaka while co-regency between the two rulers is not disputed by Redford (1985:13). Shebitku's coronation was recorded at the Temple of Amun at Karnak where he was depicted wearing a Double Crown (Redford 1985:13). His pyramid was found in El Kurru cemetery in 1919 (Ikram & Dodson 1998:315).

Taharqa (690-664 BC)

The start of his reign is well documented (Jansen - Winkeln 2006:258). It is widely accepted, although not certain, that he was the son of Piye as the inscription on the stela of Nitokris suggests (Jansen-Winkeln 2006:261). He is famous for his many campaigns to defend the Egyptian borders against the Assyrian attacks, as well as many architectural achievements in Nubia and Egypt such as the Osirian temple at Karnak (Taylor 2000:338, 355). He was defeated by the Assyrian king, Esarhaddon, and later again by his son, Ashurbanipal, before he took flight to Nubia (Taylor 2000:358-359). He was probably a brother of Shebitku (Taylor 2000:355). His royal residence was in Memphis which became the main city during the Nubian period (Taylor 2000:355). He died in 664 BC and was buried in a stone pyramid in the royal necropolis at Nuri in Nubia (Taylor 2000:359; Ikram & Dodson 1998:315).

Tantamani (664- c 655 BC)

He was the last Nubian Pharaoh. He led a military campaign to re-establish the Nubian authority over Egypt after Taharqa's defeat (Taylor 2000:359). He gained victory over the governors appointed by the Assyrians to control the northern towns but the Assyrians sent a strong army that subdued all the northern Egyptian towns and marched as far as Thebes (Taylor 2000:359). Tantamani fled to Nubia and Egypt was ruled by Psamtek who managed to reunite Egypt once more and bring an end to the Third Intermediate Period (Taylor 2000:359). He was buried in a stone pyramid at the cemetery of El Kurru which was discovered in 1919 (Ikram & Dodson 1998:315).

This brief background of the history of the period shows how much it is in the process of being written with changes that happen whenever a new inscription or document is discovered. Compared with other periods of Egyptian history, it is fair to say that the history of the Third Intermediate Period is still in the process of being established and it is likely that with more discoveries, our perception of it will look different in the future. Leahy (1985:52) suggested two reasons for the lack of information regarding this period. The first is that the location of the main centres that flourished during this period in the Delta region provides relatively less chance for archaeological remains to survive for environmental reasons related to water levels when compared to Thebes, where the dry weather and lower water table made excavations less expensive and less complicated. The second reason is the hasty excavations that do not give much attention to the upper layers in comparison with the older strata containing remains from the Old and/or New Kingdom (Leahy 1985:52).

With the limited resources and evidence regarding certain years of this period, it is clear that Egyptologists have not yet agreed about solid facts regarding many aspects. This also confirms and highlights the importance of any new information that can be obtained from the research and the study of mummies from this period.

3 Chapter Two: Mummification in ancient Egypt with focus on the burial customs and embalming techniques during the Third Intermediate Period:

3.1 Introduction:

Around 3000 BC, political and religious reasons would have initiated the idea of mummification and promoted the importance of body preserving which was believed to initially be an exclusive procedure for the Egyptian kings (Aufderheide 2003:27). However, the earliest attested examples of mummification which dates back to the Predynastic Period and recently discovered at Hierakonpolis are not the bodies of kings (Friedman 1998: 4).

Mummification is the term used to describe the bodies that underwent a procedure of decay arrest either naturally (*spontaneous*) or artificially (Aufderheide 2003:41). Immediately after death, a chemical reaction, accelerated by the body enzymes, initiates and causes the decay process by decomposing multiple structures of the body such as proteins, fat and carbohydrates to breakdown their molecules into much smaller ones easily absorbed by the soil, air and water (Aufderheide 2003:41). This process is called autolysis (Aufderheide 2003:41). Other predators such as bacteria and insects would also accelerate putrefaction by employing their own enzymes the same way as the body enzymes to produce smaller molecules that they can digest (Aufderheide 2003:41). These enzymes are affected by different factors such as temperature, acidity, presence or absence of water which would accelerate or delay the autolysis procedure (Aufderheide 2003:42-3). Dehydration, naturally (porous sand and high temperatures) or artificially (osmosis) was the main factor in the preservation mechanism of Egyptian mummies (Aufderheide 2003:43).

The techniques that were used by the ancient embalmers developed throughout the different period of Egyptian history and were affected by economic and religious factors (Zimmerman 1986:168). Each period had its own characteristic elements that were used as guidelines by researchers to assist in dating the mummies roughly to a historical period (Zimmerman 1986:168). These different aspects of mummification will be discussed below.

3.2 Mummification throughout Ancient Egyptian History:

3.2.1 Predynastic Period:

Most of the bodies preserved from this period especially from the northern cultures such as Merimda and Maadi are in the form of skeletons (Aufderheide 2003:219). On the other hand, other sites in the south such as Naqada yielded naturally preserved bodies due to the hot and dry climate which provided optimum conditions for natural preservation (Aufderheide 2003:219; David 1978:58). The dryness of the graves had a remarkable effect on the preservation of the bodies as they dehydrated rapidly and the decomposition fluids were soon absorbed by the surrounding sand which saved the body from complete decay or decomposition (Spencer 1982:29).

The body was buried in a simple grave naked and sometimes covered with a reed mat in shallow circular or oval graves in the sand at the edge of the desert as they could not afford to use the valuable fertile agricultural land as cemeteries and used the desert adjacent to their villages (David 1978:58). The burials were simple with few funerary goods which display evidence of a strong belief of life after death and the position of the body was usually on the side in the flexed position as the knees were drawn up under the chin and the hands would usually be placed before the face (Aufderheide 2003:219; Spencer 1982:29).

The phenomenon of natural mummification may have been discovered by the ancient Egyptians and later led to the development of the intentional or artificial mummification following the change to deep burials and stone sarcophagi which did not provide the suitable conditions for natural preservation of the body (Aufderheide 2003:220). Evidence of mummification as early as the predynastic period was discovered at Hierakonpolis¹³ (Friedman 1998: 4).

3.2.2 Early Dynastic Period (Dynasty 1 and 2):

¹³ Predynastic evidence of early mummification from Mostagedda such as resin soaked textile used for wrapping heads and hands has been recently studied and the results will be published in the near future (Thomas 2012: Pers Com.).

The site of Abydos is where the tomb of the first Dynasty King Djer was discovered by Petrie (Petrie 1901: 16). Human remains consist of a tightly wrapped skeletonised forearm which Petrie suggested belonged to the king himself adorned with 4 bracelets which was found inside a niche in the tomb (Fig:3.1) (Petrie 1901: 16). Only the bracelets are now on display in the Egyptian Museum, Cairo as the arm was discarded shortly after arrival at the museum by the museum director, then Brugsch, who kept the gold bracelets and threw away the arm and the linen wrappings (Brier 1994:81; Aufderheide 2003:222).

Clay and wooden coffins are known from this period (Aufderheide 2003:222). Human remains found in Saqqara show evidence of resin on linen bandages. This is considered an attempt to preserve the bodies (now skeletonised) which were still in the flexed position (Aufderheide 2003:222).

Smith reported the evidence of what was believed to be the earliest mummification attempt to the Anthropology Section of the British Association for the Advancement of Science of which he was its president during their Dundee Meeting, 4-11 September 1912 (Smith 1912a:172). Smith examined the remains found in one of the 400 tombs discovered by Quibell in Saqqara and concluded that this is the earliest attempt to preserve the soft tissue¹⁴ (Smith 1912a:172, Smith & Dawson 1924:25).

The remains which probably date back to the end of the second dynasty were of a woman, around 35 years old, in the flexed position and wrapped in well preserved wide sheets of linen except for the linen in direct contact with the body which Smith described as “*a large mass of corroded linen*” (Fig:3.2) (Smith 1912a:172; Smith 1912b:646). The linen was examined by Smith who gave detailed accounts about its quality and also mentioned the number of layers as 16 at least with 10 fine layers and 6 of coarser quality (Smith 1912b:646). Smith suggested that this is the earliest evidence of an attempt to preserve the body by using what could be crude natron (Smith 1912a:172). The skeleton which was sent to the Royal College of Surgeons in London was destroyed during a bombing raid in 1941) (Smith 1912b:646).

¹⁴ Modern excavation proved that body preservation was practised at a much earlier date (Taylor 2001a:47).

Fig:3.1 The forearm found by Petrie in the Mastaba of Djer

(from Ikram and Dodson 1998:155).



Fig 3.2:Treated body of a female from Saqqara, 2nd Dynasty. This was considered by researchers as the first attempt of mummification for a number of years before earlier examples were discovered.
(from Smith 1914:191)

3.2.3 Mummification during the Old Kingdom (Dynasty 3-6):

The process of mummification which is the artificial preservation of the body using chemicals was introduced during the Old Kingdom. The attempts to preserve the soft tissue of the mummies continued with different modifications to avoid the mistakes made previously (Aufderhiede 2003:225).

It was believed that mummification was restricted to the king and members of the royal family, and then later was allowed to the nobility (David 1982:67). However, the finds at Hierakonpolis may indicate that mummification was not restricted only to royalty at the beginning (Taylor 2001a:47). The pyramid which is the main feature of the period was built to house the preserved body of the king. The recurrent failure of preserving the soft tissues with the techniques used during the Archaic Period inspired the ancient embalmers with some successful modifications (Aufderheide 2003:225).

Derry (1942:241) mentions that it is certain that the Egyptians were not able to preserve a body during the Old Kingdom but many attempts were carried out by removing the internal organs and preserving them in canopic chests. The process of cleaning the abdominal cavity was also known as early as the late 3rd Dynasty (Derry 1942:241). Remains believed to belong to King Djoser from the Step Pyramid show evidence of a resin cast and linen wrappings, however, recent C14 research suggested that the remains belong to a much later date which indicate that they belong to a later intrusive burial (Aufderhiede 2003:225).

Resin was mentioned in Ancient Egyptian inscriptions mainly in connection with cosmetics, perfumes and mummification (Chapa 1994:525-533). It was mentioned in an ancient papyrus in relation with some funerary activities or the final preparation of the mummy (Chapa 1994:525). In this document, relatives of the deceased were to provide the various products needed for mummification (Chapa 1994:525). To preserve the facial and different features of the bodies, linen sheets soaked in resin were used during this period to make moulds into the forms of the face and genital organs (including breasts and nipples in female mummies) (Smith 1913:77).

The mummy of Re Nefer (4th or 5th Dynasty) was regarded as the earliest evidence of the practice of mummification before Elliot Smith examined the remains discovered by Quibell in Saqqara in 1912 (Smith 1912a:172, Smith & Dawson 1924:25). Re Nefer was found by

Petrie at Meidum in 1892 and was sent to the Royal College of Surgeons in London¹⁵. Amongst other specimens, this mummy is no longer available for further examination as it has been destroyed during one of the bombing raids on London in 1941 (Ikram & Dodson 1998:86). Smith gave a brief description of the mummy during a meeting of the Royal Philosophical Society of Glasgow in April 1910. He suggested that the well preserved features especially in the face are due to the application of a soft resinous material that hardened when cooled (Anonymous 1910:1369).

In 1933, Reisner discovered in Mastaba No. 2220 B at Giza, a large wooden coffin with a female mummy inside it (Derry 1942:242). The features of the woman were modelled in linen and her separately wrapped arms were straight down by her sides (Derry 1942:242). The tissues had disappeared from almost all the body parts except for some small fragments and a large part of the abdominal wall (Derry 1942:242). The mummy which was unwrapped did not show any sign of packing material in the body cavities (Derry 1942:242).

The mummy of Setka (Egyptian museum, Cairo, JE 49696) of the 5th Dynasty was investigated by Derry (1942:244) and it was found to be eviscerated and stuffed with linen but no soft tissues were preserved. It is clear that the embalmers, as early as the 4th Dynasty, knew that skin and muscles can resist decay more than viscera as they started to open the abdomen, remove the internal organs and fill the cavities with linen (Derry 1942:244).

The discovery of the four chambered alabaster (canopic) chest of Queen Hetep-Heres, mother of King Cheops by Reisner in 1928, provided important information about the process of mummification during the 4th Dynasty (Aufderheide 2003:226). Although the body of the queen was never found, the contents of the chest, which included linen packets covered with liquid, provide strong evidence that the body was eviscerated and the internal organs were removed and preserved (David 1999:543; Aufderheide 2003:226). The liquid was analysed by Lucas in 1932 and the results showed that it contains 3% of natron salt (Aufderheide 2003:226).

The remains of Djedkare Isesi, the 5th Dynasty king, were found inside his pyramid at Saqqara and were examined by Strouhal in 1993. The study of the mummy fragments proved that it was eviscerated, stuffed and wrapped with linen then covered by a layer of plaster

¹⁵ The museum archives mention a letter regarding four cases sent by Petrie in 1891 with mention of 4th and 22nd Dynasties bones and a mummy from Egypt (RCSE 2009a:116).

(Strouhal & Gaballah 1993: 104). The histological and microstructure examination of the well preserved soft tissues suggests the use of solid dry natron for the desiccation of the body (Strouhal & Gaballah 1993: 116).

In 1932, Lucas argued and gave evidences that natron salt was used in a solid form and not in a liquid form or a bath as suggested by one translation of the accounts of Herodotus on mummification (Lucas 1932:140). In 1963, Sandison (1963:267) confirmed Lucas's suggestion by conducting a scientific experiment and proved that solid dry natron, not a natron bath, was used to desiccate the bodies.

It is clear that experimentation of evisceration, desiccation and the use of hot liquid resin which stopped the rehydration of the body and prevented any bacterial and microbial growth were first introduced by the Old Kingdom embalmers who noticed the effectiveness of these techniques for the body preservation (Aufderheide 2003:225). In 1947, Derry examined the body of Prince Ptah-shepses, which was discovered inside a stone sarcophagus in a large private tomb at the north of Saqqara. The analysis of the fluid found inside the sarcophagus indicates the presence of natron salt (Aufderheide 2003:227).

3.2.4 Mummification during the First Intermediate Period (Dynasty 7-10):

As a result of the political disorder that took place during this period, it is difficult to date or relate any of the mummies to this period. The discovery of a body belonging to the 9th Dynasty proved that embalmers abandoned the body moulding technique and introduced new techniques which included covering the mummy linen wrappings with a layer of liquid resin (Aufderheide 2003:227).

3.2.5 Mummification during the Middle Kingdom (Dynasty 11-12):

Mummification which was not strictly restricted to the kings and their families (Taylor 2001a:47), continued to be available to members of the middle class during the Middle Kingdom (David 2000:373). Mummies from this period demonstrate considerable variation in practices (Aufderheide 2003:228). Resins applied to the surface of the body (not to the wrappings) and removal of the brain through the nostrils were the characteristic features of mummification during the Middle Kingdom (Aufderheide 2003:228). This latter feature was always attributed to the New Kingdom but recent discoveries provided evidences of

practising brain removal as early as the Middle Kingdom (Aufderheide 2003:228). Seven mummies dated to the Middle Kingdom were examined and the results showed evidence of cerebation (Aufderheide 2003:228).

Herodotus who wrote his accounts during the 5th Century BC, long after the great periods of the Egyptian civilisation (David 1978:71), describes the removal of the brain as follows:

“ The most perfect process is as follows:as much as possible of the brain is extracted through the nostrils with an iron hook and what the hook cannot reach is rinsed out with drugs”

(Herodotus, The Histories, Book II:86)(Sélincourt 2003:127)¹⁶.

Leek (1969:112) examined the Macalister Collection of 500 skulls most of them belonged to Egyptian priests in Cambridge and found that 56% of the skulls had a hole in the base of the skull through the cribriform plate of the ethmoid bone. The hole was made through the left nostril in 5% of skulls from this collection (Leek 1969:113). Leek carried out an experiment to remove the brain from a sheep skull using instruments modelled on the replicas on display in the Wellcome Museum, London (Leek 1969:113). He concluded that the expressions “drew out” and “hooked out” mentioned by Herodotus when describing the removal of the brain, are inaccurate as the repeated insertion of the metal instrument lacerated the brain tissue which transformed to a semi fluid form and was then drained away through the nose when the face was turned downwards (Leek 1969:113).

3.2.5.1 Mummification during the 11th Dynasty:

The mummies discovered near the temple of King Mentuhotep II at Deir el-Bahari offered a unique opportunity to study the mummification techniques in the XI Dynasty (Aufderheide 2003:228). In 1921, Winlock found the sarcophagi, coffins and mummies of six princesses, queens or concubines of King Montuhotep II while clearing around the temple (Derry 1942:246). Derry reports in detail and describes from a medical and chemical point of view the technique of mummification used to preserve the bodies of these Queens and Princesses of the XI Dynasty in his paper published in 1942 “Derry, D.E., Mummification. II Methods

¹⁶ It is important to note that the account of Herodotus regarding mummification might not be accurate with regards to mummification techniques during earlier periods of Egyptian history (David 1978:71).

practised at different periods, *ASAE* (41):240-265. These mummies which included the mummies of Ashayt, Mayt and Kemsit, showed an absence of any embalming incision as was done during the Old Kingdom but there were attempts to remove parts of the abdominal and pelvic contents using natural orifices (Derry 1942:246). This allowed the examination of remains of the internal organs which had not decomposed (Derry 1942:246).

The discovery of stained bandages and rolls of linen used as swabs and bags of natron buried with some mummies such as the materials found in the tomb of Ipi of the XI Dynasty, prove that the embalmers made an attempt to preserve the bodies (Derry 1942:246). Natron salt was applied to the surface of the bodies as an attempt of preservation of soft tissue by desiccation (Aufderheide 2003:228). The impressions of jewellery on the skin of some mummies point to the fact that the bodies were still soft when they were bandaged (Derry 1942:247). Brown beeswax was reported to have been used to cover the thighs, back and face of a mummified woman (no.23) from the same period (Raven 1983:23). Resin was applied to bandages next to the body and was found on the inner surface of the rectum which supports the second method of mummification described by Herodotus:

“...no incision is made and the intestines are not removed, but oil of cedar is injected with a syringe into the body through the anus which is afterwards stopped up to prevent the liquid from escaping. The body is then pickled in natrum (natron), for the prescribed number of day, on the last of which the oil is drained off.”

(Herodotus, *The Histories*, Book II:88)(Sélincourt 2003:128).

The cedar oil mentioned by Herodotus is not the true cedar but most probably it refers to juniper oil (Lucas 1931:21) which was used in medicine and was mentioned in the medical papyri (Kamal 1967:256). Juniper is a genus of evergreen trees or bushes of the *cupressus* family. The oil is obtained by distillation from full grown unripe green fruit. It was found in ancient Egyptian tombs as early as the Predynastic Period (Kamal 1967:156). For the poorest embalming, the expensive (imported) juniper oil would have been replaced by a cheaper local alternative such as radish seed oil (Ghaliuogui 1963:162).

Dawson (1927:49) believed that *per-anum* evisceration is not technically possible following the steps mentioned by Herodotus. According to Dawson (1929:50), juniper oil or any other

liquid would have delayed the autolysis for a short period to allow the embalmers to prepare the dehydration process.

Other examples of mummification in this period are the bodies of sixty male soldiers of the XI Dynasty found inside an undecorated tomb near the temple of Deir el Bahari by Winlock in 1923 (Aufderheide 2003:228) . It is almost certain that they were soldiers during the reign of King Montuhotep II Nebhepetre. They may have been killed in a battle probably during the 12th Dynasty and they were given honorary burial next to the temple as a reward for their braveness (Aufderheide 2003:228). As these bodies provide no evidence for abdominal incisions or any chemical treatments, considerable decomposition is attested (Derry 1942:256). Derry (1942:256) suggested that the bodies were probably left in the battle field for a period of time before they were collected and wrapped. Evidence of vultures' feeding, such as stripped muscles from tendons, can be identified in some of the bodies (Derry 1942:256). The bodies were wrapped in linen and some had a leather band around their wrists indicating that they were archers (Leca 1980:84). A reconstruction of the battle weapons was done based on careful examination of the bodies' injuries and wounds (Leca 1980:84).

3.2.5.2 Mummification during the 12th Dynasty:

The same methods of mummification used during the Old Kingdom were still practised during the 12th Dynasty. Two mummies of nobles from this period which were discovered in their tomb at Saqqara by Quibell, were found to have been eviscerated and the internal organs were removed except for the heart and the abdominal cavity was stuffed with linen before the body was wrapped with bandages smeared with resin (Smith & Dawson 1924:80). The same technique of mummification was also reported following the examination of two mummies discovered by Petrie in Rifah and the other from El Lisht, both dated back to the 12th Dynasty (Smith & Dawson 1924:82; Aufderheide 2003:228).

Some of the bodies of this period were entirely decomposed and bear no evidence of mummification whatsoever (Derry 1942:257). Twelve mummies (most of them with extended arms and a few had their arms crossed over the chest) of the same period were discovered at Dahshur (Aufderheide 2003:228).

3.2.6 Mummification techniques during the Second Intermediate Period (Dynasties 13 - 17):

Due to the social, political and economic instability, not many mummies of this period have survived. Unfortunately, the mummies of the Hyksos kings in the Delta have never been discovered (Aufderheide 2003:232). Some scholars suggest that this is due to the high humidity of the Delta where the kings were buried. Only six royal tombs of this period have been discovered up to date (Aufderheide 2003:231). The mummy of King Hor of the 13th Dynasty was discovered by Jacques de Morgan in his tomb at Dahshur (Brier 1994:252). The burial was disturbed but the discovery of the sealed canopic jars proves that the king was eviscerated (Brier 1994:252). Another set of canopic jars was discovered in the 13th Dynasty pyramid of Ameney-Kemu at Dahshur which indicates that evisceration must have been carried out on the mummy which was not found (Brier 1994: 251).

Petrie discovered at the cemetery at Qurna a 17th Dynasty intact mummy that was wrapped in many layers of linen bandages but examination proved that only the bones are preserved and most of the soft tissue was not preserved (Spencer 1982:117). Evidence suggests that evisceration took place during the mummification process of this specimen such as the discovery of linen wrappings inside the abdominal area (Smith & Dawson 1924:83).

The most famous mummy of this period belongs to Seqenenre, Taa II who led the Egyptian struggle for liberation against the Hyksos and was killed on the battlefield (Smith & Dawson 1924:83). This poorly preserved mummy which was discovered in the Deir el Bahari Cache was unrolled by Maspero in 1886 then was examined by Smith and later in 1974 by Strouhal and Bietak in the Egyptian Museum, Cairo (Smith & Dawson 1924:84; Brier 1994:256). According to Brier, the shocking results of the unwrapping and what was found led Maspero to stop halfway through the process (Brier 1994:256). The examination by Smith showed a lack of natron or any sodium chloride to preserve the soft tissues of the mummy (Smith & Dawson 1924:84). The poor preservation of the soft tissue suggests that the body was embalmed on or near the battlefield; miles away from any embalming centre at Thebes which could explain why it was not treated with natron (Brier 1994:256). Two of the five fatal cranial fractures were proved to correspond to the cross section of the certain type of battle-axe that was commonly used by the Hyksos (Strouhal 1992:213). The other upper left wounds could be caused by arrows (Strouhal 1992:213). Brier (1994:256) suggests that a blunt weapon caused the upper fracture and broke the nasal bones and other facial bones. The location of the wounds suggests that he might have been killed while he was sleeping and not during fighting which may suggest that it was a case of assassination (Brier 1994:256).

The body was eviscerated through the left side incision and sprinkled with aromatic sawdust (Brier 1994:257). There is evidence that only the abdominal cavity was stuffed with linen (Aufderheide 2003:231).

3.2.7 Mummification during the New Kingdom (Dynasty 18-20):


The kings of the New Kingdom adopted a new burial custom by choosing to hide their tombs in the desert valley at western Thebes (Brier 1994:91). This decision was motivated by the chaos and the looting of the royal tombs that took place during the Second Intermediate Period (Brier 1994:91). The low humidity in the Valley of the Kings in addition to the efforts of the Third Intermediate Period priests played an important role in the preservation of the royal mummies (Brier 1994:91).


Hundreds of mummies from this period have been found and most of them are in a good state of preservation (Aufderheide 2003:236). This has allowed mummies and the technique of mummification of the New Kingdom to be studied intensively (Aufderheide 2003:236). The most important of this group is the collection of royal mummies that is now on display in the Egyptian Museum, Cairo.

During the 18th Dynasty, the brain continued to be removed through the nose and the cranial cavity would be filled with dry linen bandages, hot liquid resin or just left empty (Aufderheide 2003:236). Although in the early 18th dynasty, the brain was not always removed as in the case of Princess Sitamun, daughter of King Ahmose (Derry 1942:259). The removal of the viscera through a lateral incision about 10-15 cm long on the left side of the abdomen continued during this period but after the reign of Tuthmosis III the location of the incision was more laterally and extended to a point near the pubic area (Aufderheide 2003:236). The heart had to remain in the body as it was regarded as an essential element for the final judgement in the Hall of Osiris (Aufderheide 2003:236). The internal organs were desiccated, wrapped in resin soaked linen and preserved in a set of four canopic jars (Aufderheide 2003:237). Palm wine (which contains about 31% alcohol) and spices were used to sterilize and clean the body cavities which then would be filled with linen packets of natron as a temporary stuffing material to help dehydrate the body which will be transferred

to another place for desiccation¹⁷ (Aufderheide 2003:237). The stuffing material would be removed after the process of dehydration of the body and would be replaced by new packets (Iskander & Shaheen 1973:77) or with linen impregnated with resin (Derry 1942:258). During the reign of Tuthmosis II, the arms of the male mummies were crossed over the chest in what is called the Osiris form and arms of the female mummies were extended with the hands on the sides of the thighs (Aufderheide 2003:237).

Resin was used more often on the linen wrappings and less so on the body itself (Brier 1994:91). According to Derry (1942:259), hot resin has an antibacterial effect that would assist in the preservation of the bodies which would explain its use by the ancient embalmers to cover the body cavity surface (Aufderheide 2003:240). Bees wax which has water repellent effects was also used in mummification as for example, it was found on the body of Hatnefer, the mother of Sennmut of the 18th Dynasty (Raven 1983:23). During the second half of the New Kingdom, the face apertures were blocked and covered by bees wax to prevent all evil powers from approaching the body (Raven 1983:23). One of the earliest examples of this practice, which continued until the 22nd dynasty, is the mummy of Ramesses V (Raven 1983:23). The technique of mummification was more or less the same through the 18th and 19th Dynasties due to the political stability of the country (Brier 1994:91).

¹⁷ There were two places for mummification; the first one is  pr nfr (Faulkner 1962:89). The purification tent which is a light wooden temporary structure opens at both ends. The ritual washing of the body would be performed in this tent (Strouhal 1992:258) the second one is

 wabt meaning the place of embalment (Faulkner 1962:57), The pure place or the embalmers work shop: were permanent buildings of mud-brick or stone surrounded with a high wall to shield them from unauthorized eyes. The ruins of the embalmers workshop at Deir el Bahari contained several small chambers where pots and packets of natron were kept along with vessels full of straw for stuffing the mummies, fragments of papyri and other things (Strouhal 1992:258).

3.3 Burial customs during the Third Intermediate Period (Dynasty 21-25):

Some evidence supports that the same burial customs known during the late New Kingdom were used during the first part of the Third Intermediate Period before major changes took place starting from the 22nd Dynasty (Grajetzki 2003:94).

3.3.1 The Third Intermediate Period Tombs:

The surviving burials of the 21st dynasty, some of which were intact, provide us with valuable information regarding the funerary traditions for all social strata of the Egyptian society not only during this period but also during the end of the New Kingdom (Grajetzki 2003:94). The northern kings built their tombs at the courtyard of the temple of Amun in Tanis seeking maximum security particularly after they experienced how the New Kingdom Royal tombs in the Valley of the Kings were robbed due to their remote location and the difficulty to provide continual and reliable security (Ikram & Dodson 1998:43; Taylor 1992b:186).

The tombs at Tanis were underground large stone chambers with reused stone sarcophagi which originally belonged to an earlier royal or private burial. For example, Psusennes I was buried in a set of two sarcophagi, one belonged to Merenptah and the second also belonged to the New Kingdom (Ikram & Dodson 1998:44). A number of burials belonged to kings and members of the royal families who lived during the 21st and the 22nd Dynasties that were found within the temple complex of Amun in Tanis including Smendes, Psusennes I, Ramses-Ankhefenmut, Wendjebaendjed, Amenemope, Osorkon I, Siamun, Psusennes II, Osorkon II, Takelot I, Shoshenq II, Hornakht, Takelot II, Shoshenq III¹⁸ (Zivie-Coche 2008:2).

The examples of the 21st Dynasty simple private tombs discovered in Thebes highlight the trend that the funerary equipment would consist of; the mummy covered with a mummy board inside a set of wooden coffins and sometimes accompanied by a set of *shabti* statues but no canopic jars or a sarcophagus were included (Ikram & Dodson 1998:44). Most of the

¹⁸ Due to the wet conditions of the Delta, the mummified bodies of the northern kings were not as well preserved as the Theban mummies. For example the remains of Psusennes I which were examined by Derry in 1940, were found in a bad state of preservation. Derry reported that the remains belong to an elderly male as the teeth showed very high levels of attrition. Evidence of advanced degenerative disease i.e. arthritis was also reported (Derry 1940: 969-970). This supported the historical records for Psusennes's 40 years of reign. Derry also examined the mummy of Shoshenq and reported that the king had a septic infection from a head wound (Derry 1939: 540-551).

tombs from this period were originally built during earlier periods for other occupants and were reused during the Third Intermediate Period (Taylor 1992b:186; Ikram & Dodson 1998:44). The tombs were not marked by any above ground structures except for in some cases tomb chapels which were reused along with the usurped tombs (Ikram & Dodson 1998:44).

Few early examples indicate that each tomb was used by one individual or a group who are probably family members but later burials from this period included a large number of coffins all crammed in one tomb such as the royal cache (DB 320), Bab el Gusus and KV35 (Taylor 1992b:186; Ikram & Dodson 1998:44). These tombs were characterised by lack of wall paintings which were replaced by rich and heavily decorated paintings on the inside and outside surfaces of the coffins and mummy cases (Taylor 1992b:186; Grajetzki 2003:95).

At Thebes, private interments were allowed within the enclosures of temples such as the Ramesseum and Madinet Habu during the 22nd Dynasty which mirrored the funerary practice in Tanis (Taylor 1992b:186). The Valley of the Kings was intensively used for private burials during this dynasty and later periods (Taylor 1992b:186)

3.3.2 The New Kingdom Royal Reburials:

The project of collecting, rewrapping and securing the remains of the earlier monarchs and their family members was carried out during the 21st Dynasty and continued during the early 22nd Dynasty (reign of Shoshenq I) (Grajetzki 2003:96; Taylor 1992b:186). This process started as early as during the reign of Ramessess XI (Aston 1991:96).

The members of early Third Intermediate Period ruling families in Thebes were buried in DB 320, together with the relocated mummies of the New Kingdom kings and queens (Grajetzki 2003:96). The restoration of the earlier rulers did not stop at rewrapping the mummy but archaeological evidence suggests that some funeral objects were restored or replaced as well according to the style contemporary to the period (Aston 1991:96). Some scholars suggested that the reason behind this massive undertaking was to protect the remains of the kings and elite buried in the Valley of the Kings as it became difficult to secure each tomb individually and a number of serious tomb robberies took place at the cemetery during the late 20th Dynasty (Taylor 1992b:186-188).

While other scholars suggested that it was an organised and authorised looting not by tomb robbers but by the necropolis administration officials, as the country suffered economic decline and the treasures buried at the Valley of the Kings were recycled and reused (Taylor 1992b:188; Grajetzki 2003:96). The royal mummies were then rewrapped and reburied with the essential funerary artefacts, not in their individual tombs but grouped in a few caches which are easier to guard (Grajetzki 2003:96).

For example, the coffin of Seqenenre bears witness to the consideration of important religious elements that were not stripped from the coffin though precious such as uraeus, the collar terminals and some of the decorations and text especially the name of Ptah-Sokar (Taylor 1992b:187-188). Yellow paint was applied to hide the damaged areas (Taylor 1992b:188). This suggests that it was not tomb robbers who committed these actions but it was done by considerate hands who respected the religious concepts of the deceased.

It is possible that a certain location was assigned for the stripping of gold sheets and other valuables such as KV 4 where some fragments of gilded royal funerary items were discovered (Taylor 1992b:188).

Some scholars suggested that some of the original contents of the New Kingdom Royal Theban tombs were reused and later discovered in the Tanis royal tombs (Grajetzki 2003:96). However, Taylor (1992b:189) disagrees with this suggestion and confirms that these items, although belonging originally to the New Kingdom kings; there is no evidence to suggest that they came from their Theban tombs. Taylor (1992b:189) suggests that these funerary artefacts could have been donated to the temple at Tanis or from other sources in the north.

Probably due to the lack of revenues from Nubia and the Levant, the only resources available to the government were the royal tombs or what had not been stolen by the tomb robbers (Grajetzki 2003:96). The administration of the royal cemetery organised the opening of these tombs and reusing the treasures (Grajetzki 2003:96). A letter dated to Payankh's time in office refers to opening one of the royal tombs at the cemetery and preserving its seal (Taylor 1992b:188). It is possible that this action was aiming to provide funds for Payankh's campaign to defend the Egyptian borders against the Nubian invasion led by Panehsy, the Viceroy of Kush, towards the end of Ramesses XI's reign (Taylor 1992b:189).

Different locations for the restoration and rewrapping of the mummies were recorded, such as the mortuary temple of Medinet Habu, the necropolis administration centre where the rewrapping of the mummy of Ramesses IX took place as indicated in its docket inscription (Reeves 1990:230). Another inscription on the linen wrappings of Ramesses III mentions Medinet Habu as well, as the location where it was restored (Reeves 1990:242). This suggestion is supported by the excavations at the site of the temple where New Kingdom funerary objects were discovered (Reeves 1990:230). However, other mummies were restored in their own tombs such as Meretamun, as Winlock suggested (Reeves 1990:230). An inscription in KV 49 mentions that large quantities of linen were stored within the tomb more than once, which indicates that the tomb might have been associated with the rewrapping of the mummies (Reeves 1990:230). Winlock (1926:25) mentioned that the mummies were rewrapped in large quantities of linen which were usually recycled old shirts, sheets and shawls, some of which were worn through and had to be stitched and mended before they were reused (Fig:3.3).

Excavations at many royal tombs at the Valley of the Kings (Ramesses I, Seti I, Tuthmosis III, Horemheb) yielded a large number of smaller funerary items which remained in the tombs and were never considered of any market value by the necropolis officials of the Third Intermediate Period, such as wooden models, weapons, statuettes and shabti figures (Taylor 1992b:190). However, the stone sarcophagi were considered as a source of building material that can be reused which resulted in a systematic breaking up of a number of sarcophagi especially from accessible tombs (Taylor 1992b:190). Other sarcophagi were reused for the burial of Third Intermediate Period Kings such as the innermost sarcophagus of Merenptah (now at the Egyptian Museum, Cairo, JE87297) that was found at Tanis, in the burial chamber of Psusennes I (Fig:3.4).

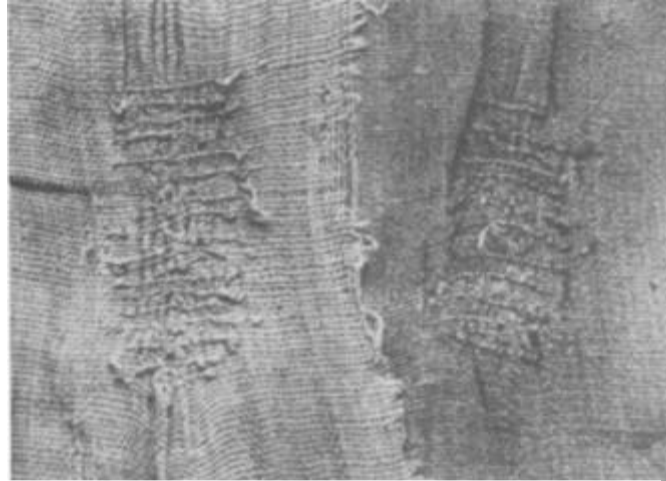


Fig:3.3 Ancient restoration of the linen used to wrap a mummy.
(from Winlock 1926:25)



Fig:3.4 The sarcophagus of Merenptah that was found in the burial chamber of Psusennes I at Tanis.
(from Ikram & Dodson 1998:262)

3.3.3 Bab el Gusus Tomb:

More than 150 priests of Amun and temple officials were buried in Bab el Gusus tomb (*the Door of the Priests*) at Deir el Bahari, also known as the “second cache” which was discovered in January 1891 (Grajetzki 2003:94; Romer 1988:156). These large numbers of coffins in addition to funerary items were packed in two chambers and two passageways (Grajetzki 2003:94). Niwiński (1984:74) suggested the tomb was constructed in two phases, shaft A, Corridor B and Chamber D are the first phase and stairs C and corridor E are the second phase. Niwinski (1984:76) also suggests that all the coffins were entered in the tomb during one transfer based on the inscriptions found with the mummies and on the manufacture and decoration style of the coffins. In 1891, the tomb was cleared following the discovery then in 1923/1924 it was cleaned again by Winlock who deposited a few objects from his excavations in the area and probably used it as a storeroom but later the 15 meter shaft was filled with sand (Niwiński 1984:75). In 1969, the Polish Archaeological team excavating at Deir el Bahari, cleared the sand from the shaft searching for some decorated stones from the Hatshepsut temple that could have been deposited there (Niwiński 1984:76). The stone blocks were never found but the team found some wooden coffin fragments (Niwiński 1984:76).

The coffins were probably collected from many smaller individual caches and tombs to be deposited in this much larger and easier to guard tomb (Niwiński 1984:78). The earliest coffins in the tomb date back to the 21st Dynasty, towards the end of the High Priest Menkheperre's (son of Pinudjem I) time in office and were found in corridors E and B (Niwiński 1984:76) (Fig:3.5 and Fig:3.6). The coffins of the family members of the High Priest Menkheperre were found in Chamber D and the coffin of Maatkare, Daughter of Pinudjem II was found in corridor B just outside chamber D (Niwiński 1984:76). The last recorded use of the tomb was probably during the reign of Psusennes II as his name appears on a mummy brace (Niwiński 1984:77). The construction of the second phase of the tomb which includes corridor E was completed during the first year of King Psusennes II (Niwiński 1984:77). This date was given by Niwiński (1984:77) as around 960-958 BC but according to Jansen-Winkeln's (2006:221) chronology this date would be around 968 BC. It is clear that the priority was given to the priests of Amun to be buried in this safe and secure tomb as their coffins were the first to be placed in the two innermost chambers of the tomb (D) (Niwiński 1984:78).

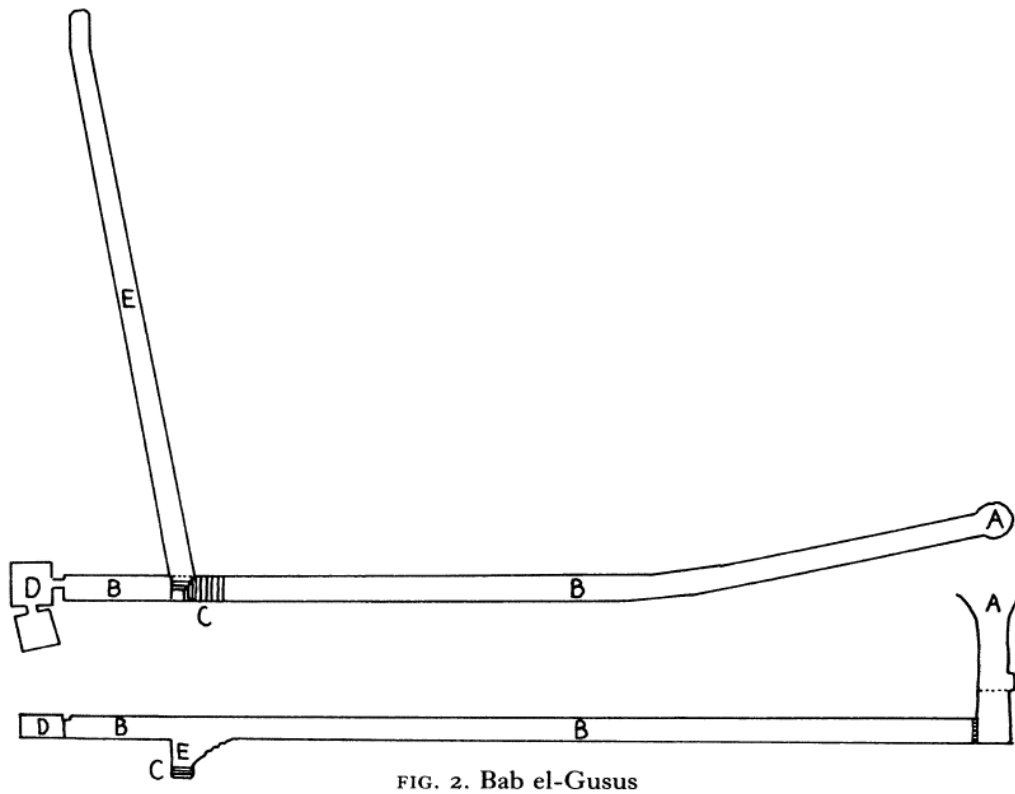


Fig:3.5 Plan and elevation of Bab el Gusus Tomb at Deir el Bahari.
(from Niwinski 1984:75)

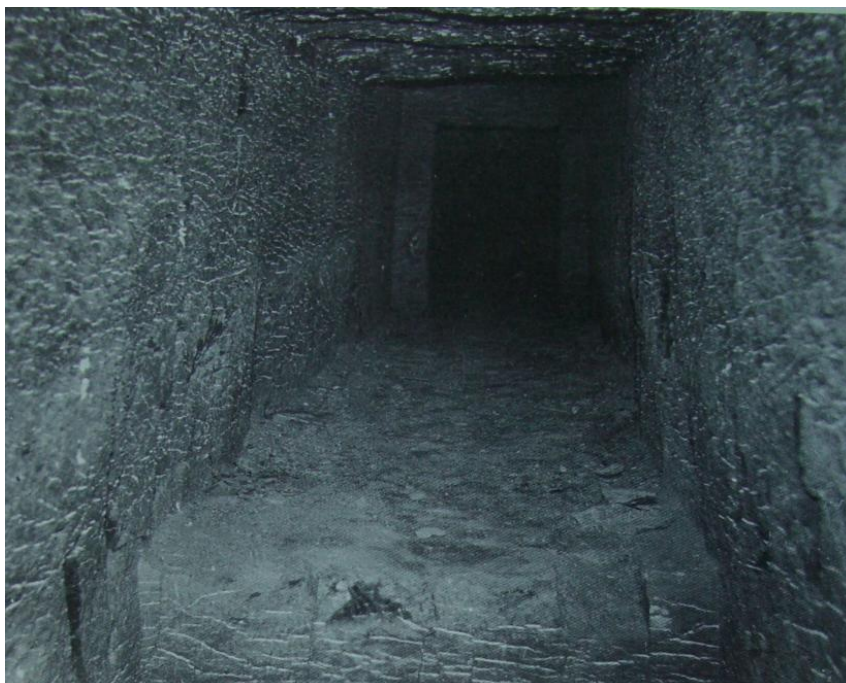


Fig:3.6 Bab el Gusus Tomb at Dier el Bahari
(from Niwinski 1988:21)

The tomb was then filled up systematically, probably during a period of a few days, with coffins and small funerary objects but in spite of the existence of space at the interior corridors, the last few coffins seem to have been packed tightly close to the shaft (Niwiński 1984:76, 78). When all the coffins were placed inside, corridor B was blocked and the shaft partially filled with sand (Niwiński 1984:78). A small niche with an artificial floor was then constructed and coffin fragments were scattered to appear as a real burial chamber in order to deceive the tomb robbers (Niwiński 1984:76).

Most of the burials consist of a nest of two coffins including a mummy board, *shabti* statuettes, Osiris figure with a papyrus, figure of Isis, figure of Nephthys and some baskets of food offerings which are the main essentials to guarantee a safe and delightful afterlife (Grajetzki 2003:94). It is interesting to note that during the 21st Dynasty, the outer coffin was always left open (i.e. the lid was not secured with locking pegs) (Niwiński 1984:80). The Book of the Dead and the *Amduat* were the main religious texts found within the wrapping of some of these mummies or inside an Osiris figure (Grajetzki 2003:94).

3.3.4 The Royal Cache:

The Theban Tomb (TT 320) originally once belonged to Pinudjem II, the High Priest of Amun and his family (Ikram & Dodson 1998:44) (Fig 3.7). Other possibilities of the initial ownership of this tomb were discussed by many scholars such as, Winlock who was the first to suggest that it belonged to Queen Inhapy (Thomas 1979:85), Thomas (1979:85-92), Romer (1988:141) and Niwiński (1984:79) who, after examining all the evidence, concluded that it belonged to Pinudjem II's family. Reeves (1990:187-190) also discusses the matter in detail.

The tomb was discovered in 1871 by Abd el Rassul, the head of a local family from the west bank at Luxor, and was considered as the family's secret treasure (Reeves 1990:183). Small items were taken from the tomb and were sold to dealers (Reeves 1990:183). The appearance of those items in the antiquities market stirred much interest and speculations that a royal tomb or more must have been discovered in the west bank (Reeves 1990:183). In 1881, The Egyptian authorities were informed and soon after the tomb was cleared of its occupants and their funerary objects by Brugsch in two days (Reeves 1990:183). The circumstances and events regarding the discovery are discussed in detail by Romer (1988:138-141).

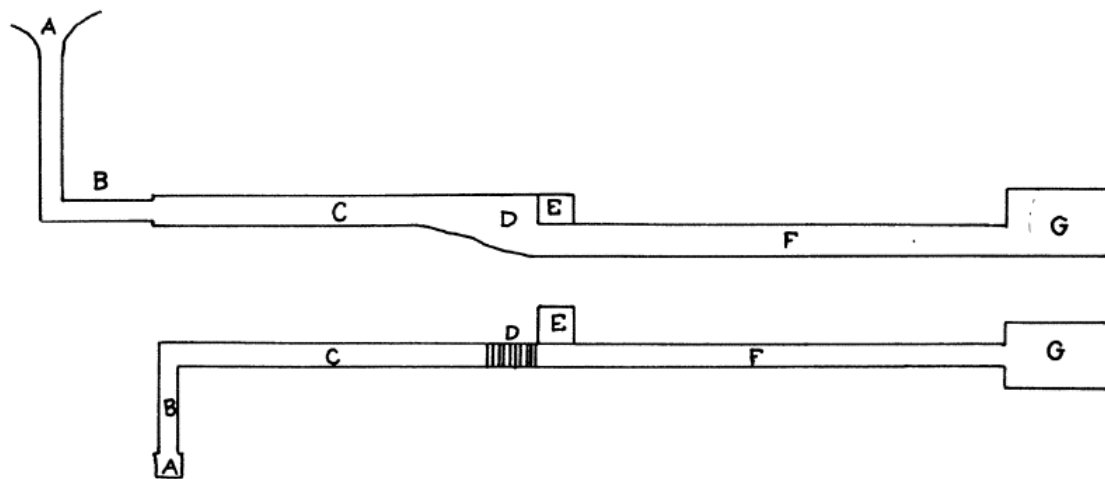


Fig 3.7: Plan of the Royal Cache TT 320
(from Niwinski 1984:74)

The location of this tomb is far more secure compared to the Bab el Gusus tomb and this could have been one of the reasons behind the preference of reusing it instead of reopening Bab el Gusus which would have involved emptying and refilling the shaft with sand each time (Niwiński 1984:76). There are similarities between TT 320 and Bab el Gusus tomb as both were constructed in two phases probably during the same period (year 5 of Siamun marks the finish of phase two of TT 320 and the completion of phase one in Bab el Gusus) and both have a similar layout (Niwiński 1984:74, 77).

The first phase of tomb TT320 included the shaft, corridor B, corridor C and burial chamber E then when the administrative authority of the royal cemetery in Thebes gave the order for this tomb to be used as a cache, phase two started by lowering the far end of corridor C to create a lower level where corridor F and burial Chamber G were constructed (Niwiński 1984:74). The second phase was completed during year 5 of the reign of Siamun prompted by the urgent requirement to use the burial chamber (G) for the coffin of Nesikhons who was the wife of Pinedjem II and the first burial to be placed in tomb TT320 (Niwiński 1984:77). Her burial included two wooden coffins, one of which was used to house the mummy of Ramesses IX (Niwiński 1984:80), and two boards with unique inscriptions stating that the shabti statues will only work for her in the afterlife by the order of Amun (Grajetzki 2003:96).

Graffiti and inscribed tags (dockets) found with the mummies provide precise dates of their transfer, reburial and in some cases the names of the necropolis officials on duty (Niwiński 1984:73; Taylor 1992b:187; Thomas 1979:89). Thomas (1979:85-92) examined the evidences available to establish the original location of each coffin in the tomb and to produce a more accurate picture of how the coffins were laid in the different chambers of the tomb. A similar study is also published by Reeves (1990:185-186). On the other hand, Niwinski (1984:73-81) reconstructed the chronology of events regarding the different interments that took place within the different chambers of the tomb based on the style of the coffins.

According to Niwiński (1984:79), the coffin of Inhapy was placed in the tomb (in chamber E) probably during the burial of Nesikhons. Shortly before year 10 of the reign of Siamun, the reburial of King Amenhotep I took place and his coffin was found in chamber E (Niwiński 1984:79). Pinedjem II died and was buried in the then fully constructed TT320, five years

after the death of his wife, in year 10 of the reign of Siamun (Niwiński 1984:77). On the same day, according to the inscriptions on the docket, the mummy of Ramesses I, Ramesses II and Seti I were also placed in chamber E which was designated for the New Kingdom Kings and Queens (Niwiński 1984:80).

The coffin of Isetemkheb, sister of Pinedjem II, was found in the royal cache and according to Niwinski it belongs to type IIIc which was in fashion towards the end of Pinedjem II's years in office (Niwiński 1984:79). The tomb had to be reopened for probably a third time to place the coffin of Isetemkheb, other royal coffins and elite members of the Theban society such as Masaharta, Maatkare and Tayuheret (Niwiński 1984:80, Ikram & Dodson 1998:44).

The coffins of Pinedjem II, Nodjmet were highly regarded and were placed in the upper chamber with the kings and queens probably because of their royal family connections (Niwiński 1984:80).

Most of the burials in this cache included the essential funerary equipment such as two wooden coffins, usually with gilded faces, a mummy board, shabti box and a number of shabti statues and occasionally wooden stelae (Grajetzki 2003:96). Funerary papyri were usually deposited between the mummy's legs within the linen wrapping (Grajetzki 2003:96).

3.3.5 Private Burials:

The tombs in the Theban necropolis were reused by private intrusive interments dated back to the end of the 21st Dynasty and to the 22nd Dynasty (Taylor 1992b:200). The mortuary temple of Hatshepsut became a popular burial place during the 25th and 26th Dynasties (Taylor 1992b:200). The royal tombs in the Valley of the Kings were also reused by private individuals during this period such as the tomb of Ramesses XI where remains of at least 3 different burials in addition to coffin and cartonnage fragments dated to the 22nd Dynasty were discovered (Taylor 1992b:200). Other Third Intermediate Period intrusive burials were possibly discovered in KV 2, KV 11, KV 14, KV 15, KV 16, KV 19, KV 21, KV 27, KV 28, KV 34, KV 39, KV 44, KV 45, KV 47, KV 57, WV 22, WV 24 and WV 25 (Taylor 1992b:201).

For example, KV 44 that was discovered by Carter in 1901 contained three intrusive mummies in addition to the plundered remains of the original burial (Reeves 1990:155). The

tomb was sealed when it was discovered but evidence of bees' nests on the ceiling suggests that it was open for a period of time following the plundering of the original burial and before the secondary burial took place (Reeves 1990:156). It was not possible to date the remains of the original burial but the Intrusive burials were dated to the 22nd Dynasty based on the cartouches of Osorkon I that were inscribed on braces from one of the mummies (Reeves 1990:156).

It is likely that these private burials were allowed in the Valley of the Kings after Year 11 of the reign of Shoshenq I, when the caches were sealed for the last time (Taylor 1992b:201). The cemetery at the Valley of the Kings declined and lost its importance when the High Priests of Amun and their families adopted the tradition of building their tombs within the Ramesseum temple compounds especially in the storerooms (Taylor 1992b:201; Grajetzki 2003:103). Lower rank individuals and officials reused the tombs in the Valley of the Kings during the 25th and 26th Dynasties such as the tombs of Khaemwese and Sety-her-khepeshef which were used for the burials of families of priests (Taylor 1992b:201). Some of the private tombs of the 22nd Dynasty were provided with a small chapel decorated with scenes of the deceased worshipping different deities (Grajetzki 2003:103-104).

Winlock discovered 3 tombs belonging to the late 21st Dynasty in Deir el Bahari; Meretamun (TT 358), the three Princesses (TT 60) and Minmose (TT 59) (Niwiński 1984:78). Funerary objects and coffins were discovered in these tombs but the Three Princesses tomb was apparently used as a small cache since a number of coffins were deposited in this tomb during one interment according to Niwiński (1984:78). The rock cut tomb which was discovered by Winlock in April 1924, was constructed during the 21st dynasty and was dated according to the style of the coffins to the reign of Pinudjem II (Winlock 1926:19; Niwiński 1984:79; Grajetzki 2003:96). When the tomb was discovered, evidence of flood damage was clearly noticeable on the decorated plaster of the wooden coffins and had to be restored before transportation (Winlock 1926:19). The original three burials found in the tomb belong to members of the family of the high priest Menkheperre who was the father of Pinudjem II, the original owner of the royal cache (TT320) (Winlock 1926:19).

The burials are:

- Henutawy, daughter of Pinudjem I and sister of Menkheperre (her coffins now in the Egyptian museum, Cairo (Winlock 1926:19)
- Djedmutesankh, daughter or wife of Menkheperre (coffins were sent to the Metropolitan Museum of Arts (Winlock 1926:20).

- Henutawy, daughter of Isetemkheb and daughter or granddaughter of Menkheperre (her coffins were sent to the Metropolitan Museum of Art then were acquired by the Museum of Fine Arts, Boston (Winlock 1926:20; Roehrig 1992:162).

The coffins of the princesses were of an excellent quality and were made specifically for them unlike the other burials that were found in the tomb (Winlock 1926:20).

When Winlock unwrapped the three mummies, he noticed that they were not intact and suggested that robbing the mummy of Henutawy, daughter of Isetemkheb, was the work of her embalmers and took place at the workshop before the mummy was buried (Roehrig 1992:163). A copy of the Amduat was found by Winlock between the mummy's legs during the unwrapping. Her funerary goods included a wooden Osiris statue which housed an incomplete copy of the Book of the Dead, a shabti box with a total of 189 shabtis (17 overseers and 172 workmen) shabtis and another with a total of 222 shabtis (20 overseers and 202 workmen) (Roehrig 1992:163).

The tomb of Minmose included the burial of another Henutawy who was 18 years old when she died (Winlock 1926:21). Her mummy was examined by Derry and it was noticed that although her coffins were of excellent quality and she was provided with large quantities of linen wrappings, her body was only wrapped and was not treated properly according to the customs of the period (Winlock 1926:21).

In 1857, Rhind discovered another cache that was prepared by the officials of the necropolis during the 21st Dynasty at Sheikh Abd el-Qurna (Dodson & Janssen 1989:125). The tomb included the disturbed remains of a group of royal princesses who lived during the 18th Dynasty (Dodson & Janssen 1989:125, 135). 14 inscribed hieratic small wooden labels were found in the tomb (Dodson & Janssen 1989:126). The style of the inscriptions on the labels indicates that the tomb dates to the early 21st Dynasty, probably during Menkheperre's time in office and to year 27 of Psusennes I (Dodson & Janssen 1989:134). The labels were similar to the royal dockets found with the royal mummies in TT320 (Dodson & Janssen 1989:134). These labels provide information regarding the names of the individuals reburied in the tomb. The name of Neferrenpet, the embalmer responsible for the reburial was also mentioned on some of these labels (Dodson & Janssen 1989:129). The same embalmer was also mentioned on another label (now in Durham) which indicates that he was in charge of a few mummy restoration projects (Dodson 1991:180).

During season 1930-1931, the Metropolitan Museum of Art expedition at the funerary temple of Hatshepsut at Deir el Bahari under the directorship of Lansing, found a number of heavily robbed vaults that once housed the burials of the Vizier Pami and other members of his family (Aston 1991:100). Evidence from the vaults suggested that they were robbed long before they were discovered by Lansing (Aston 1991:100). The finds from these vaults included some fragments from the coffin of Pami and a wooden Stela (Aston 1991:100). During the same excavation season, Lansing discovered four intact coffins on the middle terrace of the same temple (Fig:3.8) (Steindorff 1949:9). One of the intact coffins and its mummy are now in the collection of the Walters Art Museum, Baltimore following an exchange with the Metropolitan Museum of Arts in 1941 (Fig:3.9) (Steindorff 1949:9). The mummy which is wrapped and encased in a cartonnage case was examined and a CT scanning was performed at the Maryland School of Medicine, Department of Diagnostic Radiology in March 2008 in preparation for the exhibition “*Mummified*” which was open to the public for 2 years (November 2008 – November 2010) (Anonymous 2011; Anonymous 2010:8). The inscription on the case does not mention a name so one of the CT examination aims was to identify the gender of the mummy in addition to the cause and age at death (Steindorff 1949:13; Anonymous 2010:8). The mummy was found to be of a female between the age of 50 and 60 and was given the name “Mery” by the research team (Anonymous 2011). The cause of death is thought to be of Septicaemia based on the large number of dental abscesses that were detected through the examination of the CT images of the teeth (Anonymous 2011). The team also reported a prosthetic tooth, probably made of resin (Anonymous 2011).



Fig:3.8 The Walters Art Museum coffin and mummy *in situ* where it was discovered by Lansing, (the mummy on the top level)

(from Steindorff 1949:8)



Fig:3.9 The mummy from the Walters Art gallery (Accession no. 79.1) found by Lansing at Deir el Bahari.

(from Steindorff 1949:9)

Private burials' funerary artefacts from this period vary according to the social class and wealth of the owner (Grajetzki 2003:95). It has been reported that in less wealthy burials the mummy was placed inside one coffin only (Grajetzki 2003:95). Evidence suggests that the priests of Amun and private individuals preferred to include funerary items in their tombs that originally belonged to earlier kings and queens (Taylor 1992b:199). Scenes from the *Imy Dwat*, previously confined to royals, and temple reliefs appeared on the coffins and religious papyri from this period especially towards the end of the 21st dynasty and the beginning of 22nd Dynasty (Taylor 1992b:199). Niwiński investigated the papyri and the coffins and concluded that it is likely that the copy of the *Imy Dwat* on the walls of Amenhotep II's tomb was the model which was copied by the Third Intermediate Period artists (Taylor 1992b:206).

3.3.6 Elite Tomb at el Ashmunein:

In 1982, the British museum excavation team led by Spencer discovered the remains of a Third Intermediate Period tomb at el Ashmunein (Spencer 2007:49). The dating of the structure was based on strong similarities with the elite Third Intermediate Period tombs at Tanis and the Royal Necropolis of Sais such as the position of the tomb in front of a major temple and other architectural features within the structure (Spencer 2007:49). In addition to these similarities, blocks of inscribed stones and a stela that dates to the reign of Osorkon III were discovered within the site which confirmed the dating to the Third Intermediate Period (Spencer 2007:49). The tomb that the British Museum team discovered would not have stood alone in the forecourt of the temple of Thoth but it would have been one in a row of many tombs that belonged to the elite who lived in el Ashmunein during the Third Intermediate Period such as the local governor and the high priests (Spencer 2007:50).

The tomb chapels which almost disappeared during the 21st Dynasty, came back in fashion during the 22nd Dynasty and continued till the end of the Third Intermediate Period (Grajetzki 2003:102). Some of these chapels were constructed of mud-brick such as the well preserved examples from the royal mortuary temples in Thebes (at the temple of Ramesses II at Ramesseum) (Grajetzki 2003:102). Similar chapels were discovered in Abydos such as the tomb of Princess Astnkheb, daughter of Shabaka, 25th Dynasty (Mace 1902:78).

Similar tombs were discovered in the vicinity of the temple of Ptah in Memphis where a number of private elite tombs from the 22nd Dynasty were found such as the intact tomb of the High Priest of Ptah, Prince Shoshenq, son of Osorkon II (Grajetzki 2003:102). No evidence of any superstructure that belonged to this tomb was discovered but the

underground pit which was used as a burial chamber was lined with limestone and was decorated with chapters from the Book of the Dead (Grajetzki 2003:102).

Another example was reported by Gauthier (1921:21-27) at Tell Moqdam, the site of the ancient city of Leontopolis, capital of the 11th Nome of Lower Egypt. The tomb was originally excavated by Edgar in 1915 who mentioned some religious scenes in sunken relief on the limestone lined walls of the southern chamber of the tomb (Gauthier 1921:23). The name of Osorkon II was inscribed on one of the blocks that was found by Edgar inside the tomb (Gauthier 1921:23).

3.3.7 Osiris Figures:

The trend of using hollowed out wooden Osiris statues as papyri receptacles developed during the 19th dynasty and characterised the 21st Dynasty private burials but became unfashionable during the following dynasty (Taylor 1992b:198; Grajetzki 2003:94-95; Munro 2010:69). The papyrus would be hidden in the base or the body of the figure which usually depicts Osiris wearing the *atef* crown and holding the crook and flail (Munro 2010:69). The colour of the skin of Osiris could be used as an indication for dating, as the statues produced during the late New Kingdom were represented with green skin while black colour was used for the faces and hands during the 21st and early 22 dynasties (Munro 2010:69).

Aston (1991:95-107) carried out a detailed study of the different types of Osiris figures including a discussion of the Osiris figure that was created by modifying a shabti statue of Ramesses II (EA 69672). Classification of these Osiris figures into different types was carried out by Raven in 1978-79 (Taylor 1992b:205). Raven divided the statues with black varnish into three categories, while the polychrome statues were divided into four categories with additional subdivisions (Aston 1991:101-106).

3.3.7 Canopic Jars:

Due to few alterations in the mummification techniques during this period, the internal organs were treated, wrapped and re-entered in the body cavity, a development which eradicated the main role of the Canopic jars, the containers for the viscera (Taylor 2001a:72, Ikram & Dodson 1998:44). Although their practical function was demolished, their protective religious

importance was still valid, especially for the elite, which is demonstrated by the discovery of empty or dummy canopic jars in the royal tombs of the 21st Dynasty (Ikram & Dodson 1998:44; Dodson 1996:212; Taylor 2001a:73). However, earlier examples of empty canopic jars from the Old and Middle Kingdoms were deposited with mummies that had not been eviscerated (Taylor 2001a:66). Examples of symbolic canopic jars with too shallow cavities that could not accommodate packages of internal organs are known from the Third Intermediate Period as demonstrated by the painted wooden set from the British Museum, EA 9562-65 (Bierbrier 1992:164; Taylor 2001a:75). Unlike the well known traditions, the texts on this set associate Duamutef with the falcon deity and Qebehsenuef with the Jackal deity (Taylor 2001a:75). Taylor (2001a:73) suggests that this was not a simple mistake but it represents a change in the identification of the deities and their animal representatives which is apparent from other examples of the same untraditional associations on other objects such as canopic jars and coffins from this period. Other examples demonstrate an error that could have occurred in the past regarding associating a jar with a different lid such as the case of the canopic jar from the collection of the Royal College of Surgeons of England, London (Nunn & Andrews 1977:344). In this case, the inscription indicates an association with Hapy while the lid represents a jackal and not a baboon which is the traditional zoomorphic representation of Hapy (Nunn & Andrews 1977:344).

Other examples of dummy canopic jars were made of one piece of stone with an engraved line around the jar to represent the border between the body and the stopper, such as the canopic set from the Boston Museum of Fine Arts, 72.590-93, catalogue number 117, (Bierbrier 1992:164). It is not clear how many sets of canopic jars were discovered in the Bab el Gusus as Grajetzki (2003:95) mentions 4 sets while Dodson (1996:212) suggests only one set.

A few sets of canopic jars were also found in TT 320 but they were of mixed styles, sizes and shapes (Dodson 1996:212). Henutawy A's burial included 4 canopic jars which are now in the collection of the British Museum. The jars which were purchased from Sir Edward Stanton in 1913 were inscribed with the cartouche of Henutawy. However, Dodson suggests that two jars were probably made during the 18th Dynasty and the other two were contemporary to the Third Intermediate Period based on the style and the size (Dodson 1996:212). It is noticeable that two jars are of similar size; about 43 cm high (EA51814 and EA



Fig:3.10 EA 59197-EA 591200) Calcite Canopic Jars of Nesikhons, wife of Pinedjem II, 21st Dynasty found with her burial in TT 320 at Deir el Bahari. The lids of these jars are made of painted wood, each representing one of the Four Sons of Horus.
(from Taylor 2001a:74)

51817) and inscribed with the names of Imsety and Qebehsenuef while the other two jars (EA 51815 and EA 51816) are of similar size, about 39 cm, shorter than the other jars, and the name of Imsety is inscribed on both jars (BM Online Database). It has been also noticed that only one jar from this set (EA 51816) has a decoration of a collar on its shoulder (BM Online Database). On the other hand, the canopic jars that belong to Nesikhons (EA 59197-EA 59200) although of different sizes, they show some similarities and represent a full set. Each of these jars, which were donated to the British Museum in 1929, is inscribed with a spell seeking the protection of one of the Four Sons of Horus (Fig:3.10) (BM Online Database).

Although the tomb of Smendes, the founder of the northern 21st Dynasty, had not been discovered, one of his canopic jars was purchased near the northern town of San el Hagar and was acquired in 1947 by the Metropolitan Museum of Art (Fig:3.11) (Hayes 1947:263). The inscription on the calcite canopic jar, that is missing its lid, mentions the name of its owner, Nesu-Ba-neb-Dēdet, which is the ancient Egyptian name that was later transformed by the Greeks to Smendes (Hayes 1947:263). The six column hieroglyphic text assigns the jar to Qebehsenuef, the falcon headed deity who was usually responsible for the protection of the intestines (Hayes 1947:263).

The tomb of Shoshenq, the High Priest of Ptah and son of Osorkon II which was discovered in Memphis included a set of canopic jars (Grajetzki 2003:102). It is likely that only the elite were provided with canopic jars especially during the late Third Intermediate Period (Grajetzki 2003:102)

The function of the canopic jars was restored once more during the 25th Dynasty as the rulers of this period adopted the older mummification traditions of treating the internal organs, wrapping them in separate packages and depositing them each inside a specific canopic jar (Taylor 2001a:75). Examples of fully functional canopic jars are known from the burials of the Kushite rulers at el Kurru and Nuri (Taylor 2001a:75).

3.3.8 Coffins:

3.3.8.1 The 21st Dynasty Coffins:

The traditional royal *rishi* coffin design which flourished during the end of the New Kingdom was still produced during the early part of the 21st Dynasty (Ikram & Dodson 1998:43). The popular type of coffins during this period is called the “yellow coffin” (Grajetzki 2003:95). Ironically, a detailed study of the manufacturing techniques including analysis of the material and pigments used to decorate two coffins from the 21st Dynasty, carried out by Singleton in 1998 (2003:86), indicated that the yellow pigment was not always used to decorate the rich and multicoloured scenes depicted on these coffins. Singleton (2003:86) attributed the general yellow appearance of some of the coffins to the discolouration of the varnish applied by the ancient craftsman to protect the painted surfaces of these coffins. One of the coffins studied during this research belonged to Bakenmut and was found in Bab el Gusus at Deir el Bahari and is now at the British Museum (EA 24792, Fig:3.12) (Singleton 2003:83).

During the 18th dynasty, *yellow* coffins of similar style and features were produced, although the representations of different gods and individuals were relatively in a larger scale than the 21st Dynasty’s examples (Grajetzki 2003:95). The scenes or vignettes developed from being simple with few individuals during the 18th dynasty to become more elaborate and complicated during the 21st Dynasty (Grajetzki 2003:95). The plain surfaces of the carved wooden coffins were covered with a layer of plaster then some of the deities and individuals presented in different scenes on the lid were modelled from plaster and attached to the surface imitating inlays (Taylor 1989:42). Bright rich pigments were used to colour those figures before the application of a layer of varnish to protect the whole coffin (Taylor 1989:42). Women were always represented on the anthropoid coffins with wooden carved open hands while men were presented with closed hands (Taylor 1989:42).

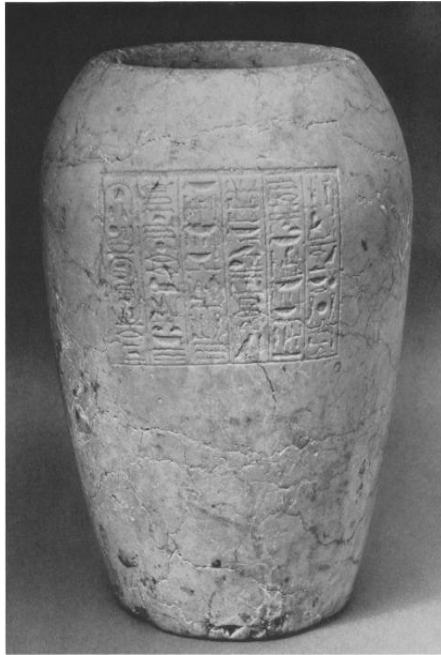


Fig:3.11 Canopic jar of Smendes, 21st Dynasty.
(from Hayes 1947:262).



Fig:3.12 (Coffin of Bakenmut (EA 24792)
(from Singleton 2003:Pl 28)

Some of the scenes on the yellow coffins of this period were usually extracts from the Book of the Dead and the *Amduat* in addition to the well known scene of the earth deity, Geb separated from Goddess Nut who was featured heavily on these coffins (Grajetzki 2003:95). The coffin itself was identified with Nut according to ancient Egyptian beliefs (Taylor 2001b:164). Therefore, the safety of the mummy inside the coffin was identified with the protection guaranteed by being inside the womb of Nut, the sky goddess, which was usually depicted under the hands on the coffin lid spreading her wings to protect the body of the deceased (Taylor 2001b:164; Taylor 1989:42). The rest of the lid and below the representation of Nut, a large number of religious scenes accompanied by short texts, occupied the entire available surface of the lid which had been divided into small compartments (Taylor 1989:42). As these scenes in previous periods occupied the vast walls of different chambers of the tombs, only the essential scenes were represented on the coffins due to the lack of space (Taylor 1989:42). Towards the end of the 20th Dynasty, the decorations on the coffins spread to the inner surfaces which were painted dark red and adorned with brightly coloured figures such as the goddess of the west which was depicted in large scale at the bottom surface of the coffin where the mummy rests (Taylor 1989:43). Other examples show the Djed Pillar depicted on the floor of the coffins during the 21st Dynasty (Taylor 1989:43).

Certain elements and changes in the designs of the coffins allow using stylistic techniques as a dating method (Taylor 1989:43). For example, the size of collar depicted about the neck of the anthropoid coffin and mummy board increased to cover the arms, a development which took place around 1000 BC (Taylor 1989:43). Also, the space that was occupied by the winged Nut has changed to accommodate a number of deities who were also represented with spread wings (Taylor 1989:43). Another important development which took place towards the end of the 21st Dynasty is the representation of the leather mummy braces on the coffin lid and on the same location, around the shoulder of the mummy, the original braces used to occupy (Taylor 1989:43).

The coffin was also considered as the eternal residency for the spirit of the deceased (Taylor 2001b:164). As the main style of coffins produced during this period was the anthropoid coffin, it could have been viewed by the ancient Egyptian as a replacement to the mummy in case it was damaged (Taylor 2001b:164). The gold sheets which were used to represent the skin and would usually cover the face and hands in addition to the blue hair reflect the desire of the deceased to be identified with Osiris (Taylor 2001b:164-165). The gilded faces and

hands were only found on coffins belong to members of the 21st Dynasty high priests' families at Thebes. Undoubtedly, these various religious beliefs related to the coffin and its function had its affect on the style and subjects of the scenes which adorned the coffin (Taylor 2001b:164). Taylor (1989:42) mentioned that our information about the coffins of this period is mainly based on the many examples that were discovered from different locations in Upper Egypt, mainly from Thebes. On the other hand, limited information is available regarding the development of coffins in Lower Egypt including the Delta due to the wet conditions which limited the survival chances of organic objects such as wooden coffins, papyri and shabti boxes (Taylor 2001b:164; Grajetzki 2003:101).

3.3.8.1.1 Examples of Theban coffins from the 21st Dynasty:

The coffins of Henutawy, daughter of Isetemkheb that were found by Winlock in TT 60 (Fig) (The Three Princesses Tomb) belong to the anthropoid varnished yellow type characteristic to the 21st Dynasty (Roehrig 1992:162). The burial originally included two anthropoid coffins and a mummy board of exquisite quality (Fig:3.13) (Roehrig 1992:163). This is known to be the usual provision for a private burial during this period while only one anthropoid coffin would be included with a poorer burial (Taylor 1989:42). The lid of the outer coffin was missing along with the faces, hands and any part that could have been covered with gold sheet or adorned with an ornament such as the forehead (Roehrig 1992:163). Winlock (1926:20) explained that the missing gilded faces and hands from the coffins could have taken place during the later burial of Menkheperre (not the high priest) but Roehrig (1992:163) disagreed with Winlock suggesting that tomb robbers were responsible for the destruction of the outer coffin lid and damage to the coffins which was later discovered by the priests probably during the later burial and it was probably the priests who covered the damaged areas with sheets of linen.

The coffin of Henutawy, now at the Museum of Fine Arts, Boston (Fig:3.14), was made of good quality wood that was covered with a layer of plaster (Roehrig 1992:163). Low relief decorations were later carved into the plaster, painted with rich colours and finally varnished (Roehrig 1992:163). The decorations include religious scenes depicting Henutawy with different gods, presenting offerings to deities and at the court of Osiris (Roehrig 1992:163).

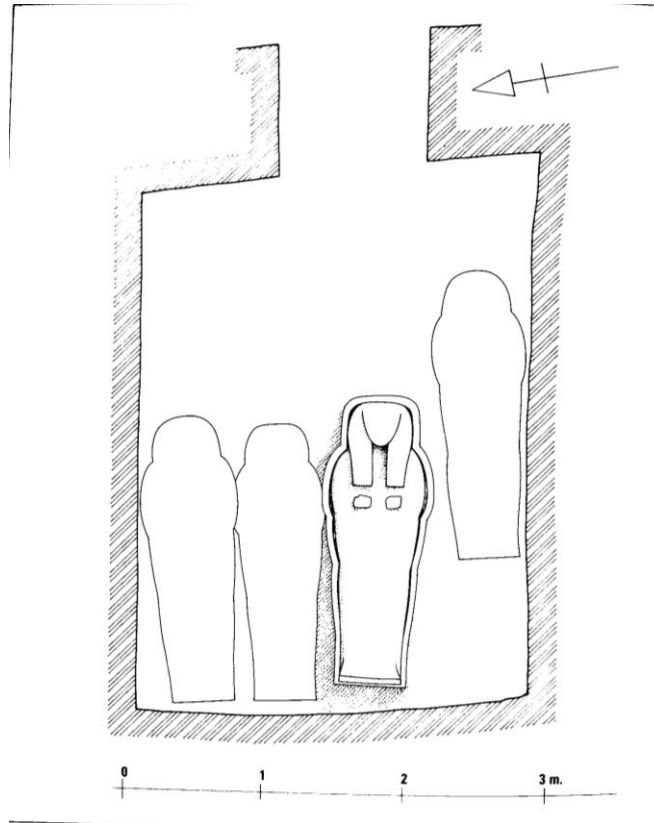


Fig:3.13 Tomb 60 at Deir el Bahari (the detailed coffin belonged to Henutawy, daughter of Isetemakhbet, 21st Dynasty

(from Roehrig 1992 :162).



Fig:3.14 Inner coffin of Henutawy, daughter of Isetemakhbet, 21st Dynasty

(from Roehrig 1992 :132).

Winlock noticed that while the coffin where the mummy of Menkheperre was found (not the high priest), originally belonged to another priest called Ahmose and the coffin made and inscribed for Ankhesmut was used to house the mummy of Nesitiset (Winlock 1926:20). Winlock (1926:20) also mentioned that the coffins of the three princesses were made especially for them and were of the highest quality of the period. There is plenty of evidence to support the existence of this phenomenon which involves coffin recycling from the Third Intermediate Period especially during the 21st Dynasty (Taylor 1992b:189). Usually, the name and titles of the new occupant would replace the name and titles of the original owner but other cases when the original name was left on the coffin are also known (Taylor 1992b:189).

Some other modifications had to take place for the coffin to be suitable for the new occupant such as altering a coffin which originally belonged to a female to house a male occupant (Taylor 1992b:190). Minor size alterations were also made in order to fit a longer or wider mummy in a coffin such as the case of the mummy of Unknown man E who was found in the royal cache (TT320) (Brier 2004:Per. Com). Visible chisel marks on the interior walls of the white plain coffin are clear evidence of the size alteration that was made by the necropolis officials in order to place the mummy inside the narrow coffin (Brier 2004:Per. Com) (Fig:3.15).

Another example of reused coffins is the burial set of Pinedjem I which originally belonged to Tuthmosis I (Taylor 1992b:191). The identity of the mummy found inside these coffins is not clear but an inscription inside one of the coffins mentions the name of Pinudjem I. The reasons behind Pinudjem I's decision to reuse coffins that are more than 500 years old for his burial are not clear but Taylor (1992b:191) suggests that it could have been to assert his claim to the throne in the south by associating himself with Tuthmosis I. Taylor (1992b:199) suggested that it is possible that Tuthmosis I was revered during the 21st Dynasty and Pinudjem I was hoping to benefit from this association in the afterlife. These coffins were carefully stripped of their gold sheets suggesting an act of the cemetery officials (Taylor 1992b:191).



Fig:3.15 The plain white coffin where the mummy of “Unknown Man E” was found. Chisel marks are visible on the interior wall of the coffin (arrow). This procedure was probably performed by the necropolis officials to accommodate the shoulders of the mummy inside the slightly narrow coffin.

(from <http://www.archaeology.org/0603/abstracts/mysteryman.html>
(Accessed on 26/ 1/2011))

3.3.8.1.2 Northern Coffins:

Regarding the royal burials in Tanis, large quantities of gold and silver funerary items were found inside the royal tombs such as gold masks, mummy boards and full silver coffins (Ikram & Dodson 1998:44). The contents of the tomb of Psusennes I that was discovered by Montet in 1939, provide strong evidence of the power and wealth that the northern kings maintained during their time in power (Taylor 1989:41). Psusennes I was buried in a spectacular solid silver and gold overlay anthropoid coffin that is a clear demonstration of the superb ancient Egyptian metal- smiths' techniques which reached its peak during the Third Intermediate Period (Taylor 1989:41, Becker *et al* 1994:45). The coffin bears unmistakable resemblance to the two innermost coffins of Tutankhamun as it is decorated with feather pattern and represents the king wearing a headdress and holding the traditional royal sceptres (Taylor 1989:41).

In Egypt, silver naturally occurs within galena or lead ores which are known to be located in the Red Sea area but it is likely that the ancient Egyptian silver was obtained from a natural gold and silver alloy that contained a higher percentage of silver (Lucas 1928:314-318). It is widely accepted that during the New Kingdom, quantities of silver extracted from galena were imported to Egypt (Becker *et al* 1994:47). Both hammering and casting techniques were used in the manufacturing of silver coffins and vessels from this period (Becker *et al* 1994:47). According to the ancient Egyptian beliefs, Silver is associated with the moon, the bones of the gods and religious ceremonial purity (Becker *et al* 1994:47). A gold mask (Fig:3.16) was found inside the silver coffin together with a decorated mummy board made of a sheet of gold covering the decayed remains of Psusennes I (Taylor 1989:41).

This tomb also included a small burial chamber for Wendjebaendjed who lived during the reign of Psusennes I and his titles refer to him as the overseer of the troops and the high steward of Khonsu (Grajetzki 2003:98). It is likely that Wendjebaendjed could have been related to or a close friend of the king to be allowed a burial chamber within the royal tomb and for his name to be inscribed on a short sword that belonged to Psusennes I and was found in the king's burial chamber (Grajetzki 2003:98). Chapters from the Book of the Dead were painted on the walls of Wendjebaendjed's small burial chamber where the usurped 19th Dynasty red granite sarcophagus occupied almost all the floor space (Grajetzki 2003:98). Wendjebaendjed was provided with a gilded wooden coffin, a decorated silver anthropoid

coffin and a bead net covering his mummy (Grajetzki 2003:98). A large number of jewellery pieces, weapons and amulets including finger and toe gold covers were found within the mummy. Four decorated silver and gold bowls, a gift from the king, were found inside the innermost coffin of Wendjebaendjed (Grajetzki 2003:98).

3.3.8.2 The 22nd Dynasty to 25th Dynasty coffins:

The yellow coffins of the 21st Dynasty went out of fashion during the 22nd Dynasty and other coffin types became popular (Grajetzki 2003:101). Plain and simple outer coffins with one line of inscriptions appeared during this period (Grajetzki 2003:102).

3.3.8.2.1 The Royal coffins:

The coffin of Shoshenq II is a good example for the major stylistic changes that took place during this period (Taylor 1989:47). The silver anthropoid coffin of Shoshenq II that was found inside one of the chambers in the tomb of Psusennes I, represents the king with a falcon head illustrating the association of the king with Horus (Fig 3.17) (Taylor 1989:47), Sokar or Ptah-Sokar-Osiris (Broekman 2009:75). The rest of the coffin lid was divided into compartments using lines of inscriptions and occupied with religious scenes of different deities, except for the representation of a winged ram-headed deity on the chest (Taylor 1989:47). The mummy of the king was encased in a gilded cartonnage mummy case representing the king with a similar falcon head (Fig:3.17) (Taylor 1989:47). Fragments of the cartonnage of Osorkon II that was found in Tanis and the sarcophagus of Harsiese that was found in Medinet Habu, both show evidence that depicting the king with a falcon head on his coffin and cartonnage was the royal fashion during the 22nd dynasty (Taylor 1989:47).

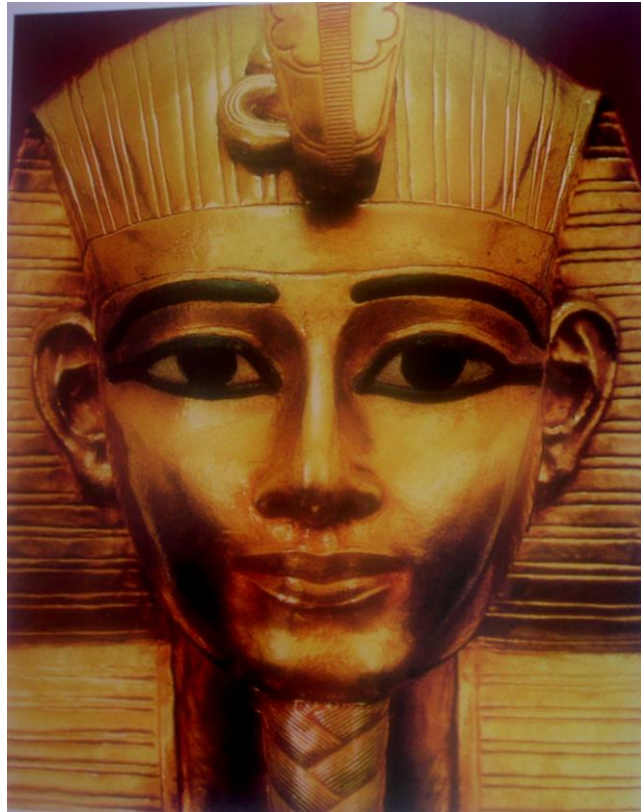


Fig:3.16 Gold mask of Psusennes I, Egyptian Museum, Cairo JE 85913. (from Ikram and Dodson 1998: 180)



Fig:3.17 Falcon-headed silver coffin (left) and cartonnage case of Shoshenq II (right)
(from Broekman 2009:68)

3.3.8.2.2 Theban coffins:

The yellow coffins fall out of fashion especially during the reign of Osrokon I and were replaced by a different type of coffin that had its own distinguished shape and decorations (Taylor 1989:47). Wooden coffins of simpler forms were produced in Thebes during the 22nd Dynasty (Taylor 1989:47). Some of the details on the lids that were produced prior to this period ceased to exist such as the modelled elbows and crossed hands (Taylor 1989:47). The standard burial set during this period consisted of up to three anthropoid coffins that protect the mummy which was encased in a heavily and brightly painted full cartonnage case (Taylor 1989:47).

3.3.9 Shabti Figures:

The *shabti* figures from this period were usually crude and made of blue faience (Grajetzki 2003:95). The lack of quality was probably compensated by depositing a large number of shabti statues with each burial (Grajetzki 2003:95). The standard *shabti* spell usually inscribed on the body of the statue started to become less fashionable and was replaced with a more simpler formula which only included the name and titles of the deceased (Grajetzki 2003:95). The burial of Henutawy, daughter of Isetemkheb that was found by Winlock in 1924 in TT 60, included two shabti boxes with a total of 411 shabtis (Roehrig 1992:163).

Some modifications were carried out on earlier shabti figures during the Third Intermediate Period, especially during the reburial of the New Kingdom royal mummies. One example is the wooden Shabti of Ramesses II (now at the British Museum, EA 69672) which was transformed to an Osiris figure by modifying the shape of the Nemes headdress to resemble a lappet wig, adding a thin layer of mud plaster all over the figure, adding a rectangular wooden base and a layer of black varnish (Taylor 1992b:198). The name of the new owner of this figure is unknown as well as the reason behind the modification of this particular statue (Taylor 1992b:199). It is possible that Ramesses II was revered during the Third Intermediate Period especially during the 21st and 22nd Dynasty. This suggestion is supported by the discovery of a religious text entitled “The book that was found at the neck of the mummy of King Ramesses II in the necropolis” with the 21st Dynasty mummies from the tomb of Bab el Gusus (Taylor 1992b:199). Such a book was not found when the mummy of Ramesses II was unwrapped following the discovery of the royal cache but it could have been found by the cemetery officials during the 21st Dynasty who were responsible for restoring

the mummy (Taylor 1992b:199). A detailed study of this Shabti/Osiris figure was carried out by Aston (1991:95-107).

In 1939, Pierre Montet's discovery of the intact tomb of Psusennes I, in Tanis shed a light on the royal funerary practices of the northern kings including the shabti figures¹⁹ (Clayton 1972:172). The gold and silver treasures that were found in the tomb were taken immediately after the discovery to be safely deposited in Cairo just before the outbreak of the war, while the rest of the finds remained in Tanis (Clayton 1972:172). In 1943, the storeroom was broken into and hundreds of objects were stolen (Clayton 1972:172). These objects which were yet to be described in detail by Montet, appeared later in the antiques market and a number of them are in museum and private collections (Clayton 1972:172). As a result of these events, it is not clear how many shabti figures were discovered in the tomb²⁰ (Clayton 1972:172).

Around 226 worker shabtis and 15 overseers, belonging to Psusennes I, were located in different private and public collections by Clayton (1972:173). According to Montet, one group of these shabti figures were made of cast solid bronze and were provided with faience tools (Clayton 1972:173). The average height of these figures is about 8cm and they were all inscribed with the cartouche of Psusennes I, beloved of Amun (Clayton 1972:173). The worker shabtis were represented in the mummy-form wearing a wig with, below the shoulder front and back, lappets. The arms were crossed on the chest, holding a hoe with each hand. A small rectangular bag is incised on the back of each worker figure (Clayton 1972:173). Each overseer figure, on the other hand, was represented with a beard and a front stiff kilt where the cartouche of the king is incised (Clayton 1972:173). Examples of Psusennes I bronze shabti statues are in the collection of the Fitzwilliam Museum, Cambridge, such as (E 149.1954 bronze, E 640.1954 overseer, E 646.1954 faience with black details, E690.1954 faience with black details). The online database of the Fitzwilliam Museum refers to the source of these shabtis as from Robert Greg. The shabtis were all acquired in the same year as is apparent from the accession numbers (Fig:3.18). Another shabti in the same collection

¹⁹ For more information on the excavations and the discovery of the royal tombs at Tanis see the three volumes published by Montet, P. *La Nécropole Royal de Tanis*; Vol I, *Les constructions et le tombeau d'Osorkon II* (Paris 1947), Vol II, *Les constructions et le tombeau de Psousennes* (Paris 1951), Vol III, *Les constructions et le tombeau de Chechonq III* (Paris 1960). Montet also published the reports from the excavations at Tanis in Montet, P. (1942) *Tanis: Douze années de fouille dans une capital oubliée de delta Égyptien*, Paris.

²⁰ An exhibition of a collection of artefacts from Tanis entitled "Gold of the Pharaohs" was organised in 1988 by the City of Edinburgh Museum and Art Galleries.

belonged to Psusennes II (E 445/ 1982) and from Tanis, according to the museum's online database, (<http://www.fitzmuseum.cam.ac.uk>). Another bronze shabti worker figure from the tomb of Psusennes I is in the collection of the British Museum EA 68526 along with a faience shabti figure that represents Osorkon as a boy with black curly hair, EA 8962, (Fig:3.19) (The British Museum Online Database).

Examples of Shabti figures included in burial equipment during the 22nd Dynasty are known such as Shoshenq, High Priest of Ptah in Memphis and son of Osorkon II (Grajetzki 2003:101). Prince Shoshenq's burial included a large number (around 200) of high quality Shabti figures (Grajetzki 2003:102). Another example is the burial of Nakhtefmut, the "God's Father" and "Door Opener at Karnak" whose tomb was discovered in Thebes (Grajetzki 2003:104). Two wooden boxes of Shabti figures were provided to his burial (Grajetzki 2003:104).



Fig:3.18 Cast bronze shabti overseer figure of Psusennes I from the collection of the Fitzwilliam Museum, Cambridge (E 149.1954), originally from the collection of Robert Greg who acquired them while in service in Egypt as the British Commissioner for the Egyptian Debt. He is known for donating a large number of bronze figures to the museum.
(Black and white photos:from Clayton 1972:Pl XXXIV)

(Coloured photo from:

http://www.fitzmuseum.cam.ac.uk/opac/search/cataloguedetail.html?&preref=125489&_function=_xslt&_limit_=10

©The Fitzwilliam Museum, Cambridge (Accessed on 29/ 1/ 2011)



Fig:3.19 Faience shabti figure of Osorkon, 22nd Dynasty, represents him as a boy with black curly hair.

http://www.britishmuseum.org/research/search_the_collection_database/search_object_details.aspx?objectid=140422&partid=1&IdNum=8962&orig=%2fresearch%2fsearch_the_collection_database%2fmuseum_number_search.aspx

The British Museum Online Database (Accessed on 29/1/2011).

3.3.10 The Development of Cartonnage Cases:

The word cartonnage refers to the layers of glue impregnated linen that is covered with plaster and usually brightly and heavily painted with different religious scenes (Taylor 1992a:166). Although the technique of producing cartonnage objects was known as early as the First Intermediate Period when it was used by the ancient craftsmen to make mummy masks, it was not utilised as replacement of inner coffins and in the production of complete mummy cases until the Third Intermediate Period (Taylor 1992a:166). During the Ptolemaic Period, recycled papyri sometimes replaced linen in the production of cartonnage cases and masks (Grajetzki 2003:101).

The development of funerary traditions during the 22nd Dynasty is highlighted by replacing the mummy mask, mummy board and the inner coffin with a painted full cartonnage that encases the whole mummy (Taylor 1992a:166; Grajetzki 2003:101). Evidence suggests that the production of full cartonnage cases took place during the reign of Shoshenq I and not earlier (Taylor 1992b:201). These cartonnages or mummy cases were much lighter in weight, compared to a wooden coffin, and were heavily painted with different religious vignettes on the white plaster background (Taylor 1992a: 166). It is not hard to imagine that the light weight mummy cases must have been welcomed and appreciated by the relatives or the groups of cemetery officials responsible for carrying the heavy ensemble which included the wrapped mummy inside the mummy case instead of a heavy wooden coffin to its final resting place which is usually through a deep and narrow shaft. The new trend proved to become very popular among all different levels of the society in the north and the south especially that the production of a mummy case was affordable (Taylor 1992a: 166; Grajetzki 2003: 101). Royal burials from this period were also provided with mummy cases as the excavations of the royal tombs at Tanis revealed (Taylor 1992a: 166).

The burial of Nakhtefmut, an official at the temple of Amun at Karnak who lived during the 22nd Dynasty, included three wooden coffins and the mummy which was encased in a full brightly coloured catronnage case with a gilded face (Grajetzki 2003:104). Dating the burial of Nekhtefmut to the reign of Osorkon I was based on the inscription that was found on a leather mummy brace that was deposited with the mummy (Grajetzki 2003:104).

3.4 The Mummification Process during the Third Intermediate Period:

Mummification techniques went through different stages during this historical period. At the beginning of this period, the 21st Dynasty, embalming techniques reached their acme (Gray 1966:138; Taconis 2005:38). After this the technique deteriorated until it disappeared at the beginning of the Christian era (Gray 1966:138). Detailed study of a collection of 10 mummies dating back to the 21st dynasty was carried out by Winlock as he conducted documented unwrappings of the mummies he discovered during his excavations in the Theban Necropolis (Winlock 1926:21). The purpose of the unwrapping was to retrieve any artefacts that were placed within the wrapping such as any amulets, jewellery or papyri and to use the notes taken and photographs during the unwrapping to rewrap the mummies again (Winlock 1926:21). The examination of the mummies which belonged to a wide range of the Egyptian society was carried out by Dr. Douglas E. Derry (Winlock 1926:21).

At the beginning of the 21st Dynasty, the embalmers introduced fundamental changes and revolutionary concepts to the mummification process (Smith & Dawson 1924:110). They had mastered the traditional techniques and were seeking perfection by aiming to retain the life-like form of the body and to preserve its features so that the mummy would be a true and complete representation of the deceased (Smith & Dawson 1924:111). It is also important to note that the embalmers of this dynasty gained valuable experience and knowledge when they rewrapped and restored the mummies of the kings and queens of the New Kingdom. These mummies were disturbed by the tomb robbers who wanted to steal the amulets and gold jewellery that were hidden between the linen wrappings (Smith & Dawson 1924:110).

3.4.1 Cosmetic modifications:

The embalmers must have been disappointed by the shrivelled and deformed features of some of these mummies which highlighted the need for applying new “cosmetic” mummification

techniques (Smith & Dawson 1924:110-111). They noticed that the facial appearance of the deceased changed after mummification, as the mummies appeared shrivelled and thin, so packing material {sand, linen, sawdust mixed with a fatty material such as butter or grease and in some cases mud (Ikram & Dodson 1998:124)} were placed in specific areas of the face and body so it would have a life-like appearance (David 2000:374). Packing material was reported to have been found during the examination of the mummy of king Amenhotep III (18th Dynasty /1391-1353 BC.) probably the embalmers were trying to retain the appearance which the obese king had during his lifetime (David 2000:374).

As many as seventeen incisions were made in specific areas of the skin to allow the embalmers to reach and fill the space between the body and the skin with the packing material (Fig:3.20) (Ikram & Dodson 1998:124). The locations of the incisions are mentioned in the Bremner- Rhind Magical Papyrus which was written around 200 BC. as one in each arm, one in each leg, four incisions in the chest, seven in the cranium, one in the left side of the abdominal area and one in the back (Ikram & Dodson 1998:124). Most of the discovered mummies from this period were reported to have no more than five incisions (Ikram & Dodson 1998:124). Rolls of linen were used to keep the filling in place while the embalmers stuffed all the areas (Ikram & Dodson 1998:124).

During the unwrapping of the mummy of Henutawy (21st Dynasty), daughter of Isetemkheb, from TT60 , Winlock reported that the body cavity was entirely filled was sawdust (Roehrig 1992:163). Winlock also gave brief account of the mummification process during the 21st Dynasty and this is what he said regarding the packing process:

“.....the under-taker then proceeded to give the body what was conceived to be a natural look. Salt, soda, ashes, and sawdust were rammed into the arms and legs and even into the cheeks of the corpse until it was literally stuffed into a travesty of the human form-an operation which left many evidences of rather rough handling, even necessitating an occasional leather patch to make good the damage done to the skin. ”

3.4.2 Internal organs:

Packing the body was not the only change the embalmers undertook during this period. As an essential step of the mummification process, the internal organs (stomach, lungs, intestines and liver) were usually removed from the body, treated with natron, wrapped separately and kept inside four canopic jars (David 2000:374). These jars were placed inside a box which was always found next to the coffin in the tomb (Taylor 2001a:65, David 2000:374). The embalmers of the 21st Dynasty returned the internal organs back to the abdominal cavity after treating and wrapping them separately with linen bandages (David 2000:374). A wax figurine of one of the Four Sons of Horus was often wrapped with each organ (Forbes 1993:201). These figurines were usually made of beeswax, but examples made of other materials such as, resin, clay with an external layer of wax or resin with a wax layer, are also known (Taylor 2001a:72). This practice provided evidence for the widely accepted associations of each organ with one of the Sons of Horus as it has not been inscribed on the canopic jars or in any other ancient text (Taylor 2001a:66). The liver was assigned to Imsety, the lungs to Hapy, the stomach to Duamutef and the intestines to Qebehsenuef (Taylor 2001a:66). Evidence also suggested that this association was not a strict rule as exceptions were also discovered (Taylor 2001a:66).

The thoracic and abdominal cavities were packed with sand, linen and natron (Forbes 1993:201). The reasons behind adopting this new trend are not clear but the intention of preserving the whole body as one unit, including the treated organs which are essential to achieve a successful resurrection, could have been a major element for these changes (Taylor 2001a:72). The mummy of Ramesses V (20th Dynasty) is one of the earliest examples of this procedure which became a standard practice during the Third Intermediate Period (Taylor 2001a:72). Some variations were also discovered such as the mummy of Irtyru, a woman who lived during the 25th Dynasty, as the wax figurines were placed within her linen wrappings and not inside the body cavity (Taylor 2001a:72).

Winlock found 7 packages inside the body cavity of the 21st Dynasty mummy of Henutway, daughter of Isetemkheb, TT60 (Roehrig 1992:163). The packages were unwrapped and four wax figures representing the four sons of Horus were found inside four of these packages while the other packages only contained human remains (Roehrig 1992:163). In one case of another female mummy, these packages contained a piece of rope instead of the intestines, a

fragment of cowhide instead of the liver and different pieces of leather and linen to form the 7 packages of which four of them contained the small wax figures of the four sons of Horus (Winlock 1926:24). Winlock suggested that either the organs perished while treated or they were discarded by the embalmers (Winlock 1926:24).

3.4.3 False eyes:

The embalmers were also not satisfied with the appearance of the eyes after mummification so they placed false eyes made of different materials such as stone, glass (Baldock *et al* 1994) and painted linen on top of the original eyes (David 2000:374). Pettigrew reported “enamelled eyes” in a mummy from Thebes that was unwrapped for the members of the British Archaeological Association (Pettigrew 1849:348). Smith examined forty four mummies from this period and he found that only two of the mummies had stone eyes and the rest had eyes made from layers of linen packed under the eyelids (Gray 1971:125). One case of artificial eyes which could be identified as faience or enamel plaques was recorded by Macalister (1894:116).

During the unwrapping of the 21st dynasty mummy of Henutawy, daughter of Isetemkheb from TT 60, Winlock reported that glass eyes were found (Roehrig 1992:163). Winlock also mentioned that in some cases, small balls of linen with a black dot in the centre to represent the eye pupil were used as false eyes as they were found under the eyelid of the mummies (Winlock 1926:23).

During the examination of the mummy collection in the Náprstek Museum in Prague, both X-rays and chemical analyses were carried out to determine the material of the artificial eyes found in one of the mummies. The results of the analyses showed that they are made of calcium carbonate –calcite (Čejka *et al* 1976:138).

In 1971, Gray published his radiological examination of artificial eyes in the mummies in which he mentioned such eyes were used during the 20th Dynasty as they were found in the mummy of Ramesses III (Gray 1971:125). Two small onions were pushed under the eyelids of the mummy of Ramesses IV which gave the mummy a highly realistic lifelike appearance (Gray 1971:126). The same mummification techniques that were introduced during the 21st Dynasty were also employed during the following 22nd and 23rd Dynasties (David 2000:374).

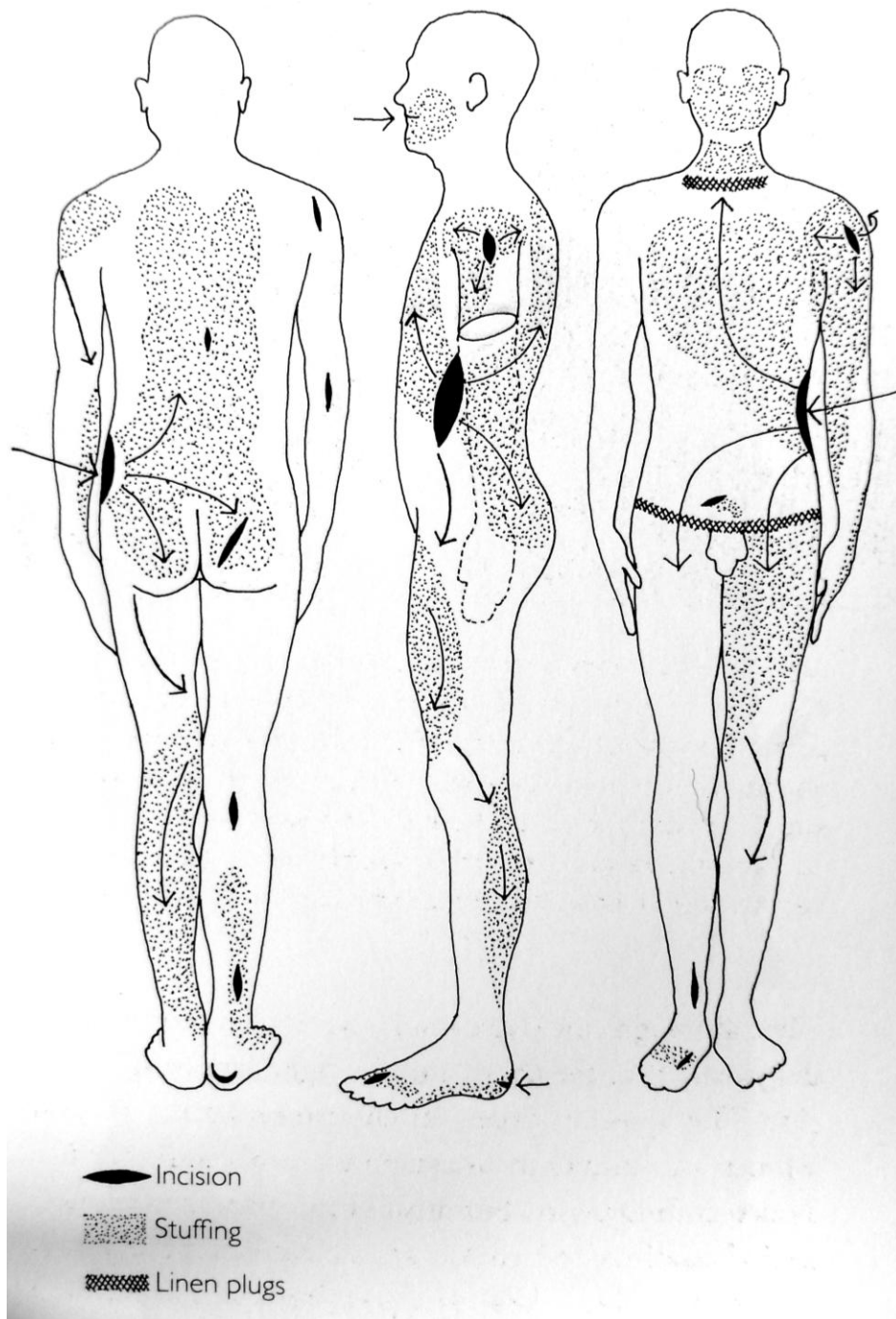


Fig:3.20 Diagram illustrating the locations of the subcutaneous packing, the incisions, the linen plug and the stuffing that was performed by the embalmers during the 21st Dynasty.
(from Ikram & Dodson 1995:124)

4 Chapter Three: Imaging and the study of mummies :The use of modern technology in the scientific investigation of mummies:

4.1 X-ray Radiology and Paleoradiology:

Shortly after Wilhelm Konrad Röntgen (1845-1923), the German physicist, discovered X-rays in November 1895, mummified remains were examined by this new technique (Taconis 2005:42; Fiori & Nunzi 1995:67). In March 1896, just a few months after Röntgen's discovery, the German physicist Walter König (1859-1936) examined the mummy of a child from the Senckenberg Museum in Frankfurt on Main, Germany, and the mummy of a cat from the collection of the Municipal Historical Museum also in Frankfurt using the new technique (Taconis 2005:42; Böni *et al* 2004:203; Isherwood 1995:304). In March 1896, König produced 14 images of the mummies and published his booklet "*14 Photographien mit Röntgenstrahlen aufgenommen im Physikalischen Verein*" (Fig:4.1) (Tiggelen 2004:10; Isherwood *et al* 1979:25). In his accounts of these investigations that were probably carried out using the new installation in the physical department of the institute of the Frankfurt Physical Society, König says

“...on February 2,...with Dr. Tischendorf, we also made pictures of many other subjects, animals, parts of mummies.”

(Glasser 1933:246)

In Belgium, Van Heurck (1838–1909) X-rayed an ibis mummy in the same year (Fig:4.2) (Tiggelen 2004:10). Before the end of the same year, 1896, Thurstan Holland examined 261 objects including wrapped mummy birds using X-ray apparatus in Liverpool (Isherwood 1995:304; Posner 1970:359). In Vienna, Alexander Dedekind discovered that a child mummy under examination was actually a mummified ibis (Taconis 2005:42; Glasser 1933:347). Dedekind's main interest was using the X-ray to discover pseudo mummies (Böni *et al* 2004:205). His work was published in 1897 in the *British Journal of Photography* and in *Prometheus* (Böni *et al* 2004:205).



Fig. 4.1 The first radiographs published by Walter Koenig in 1896. The X-rays show Antero-posterior view of the knees of an Egyptian child mummy from the collection of Senckenberg Museum, Frankfurt. The exposure time was 14 minutes as reported by Koenig. (from Böni *et al* 2004:204).

In Philadelphia in 1896, J. Garbutt, a photographic plate producer, used X-ray radiography to examine a mysterious wrapped object to discover that it contained a mummified human hand (Taconis 2005:43). It seems that Garbutt also examined a mummified human foot using the same technique (Glasser 1933:348). The mummified remains were a popular choice among the first specimens to be examined using X-rays, as they did not move in front of the early X-ray machines while very slow-exposure photographic glass plates, as suggested by Holland in his publication, were used (Isherwood *et al* 1979:25). Some reports mentioned that in May 1897, an X-ray machine was built in the laboratories of the University of Pennsylvania where a Peruvian mummy of a child was X-rayed by Dr. Charles Lester Leonard (Fiori & Nunzi 1995:68). Dr. Stewart Culin, Director of the Museum of Science and Art at the University of Pennsylvania, reported the examination of this mummy in his article *An Archaeological Application of the Roentgen Rays*, in 1898. He described the radiographic finds but he did not publish any of the images (Böni *et al* 2004:206). At the end of this report, the author points out the importance of the non invasive factor of X-ray examination especially for museum artefacts (Böni *et al* 2004:207).

In the same year, 1897, Flinders Petrie (1853-1942), the renowned Egyptologist, contacted the anatomy department at University College London concerning the possibilities of X-raying some of the mummified remains from the Old Kingdom that he had discovered earlier in Egypt (Taconis 2005:43; Fiori & Nunzi 1995:68). Petrie was studying the possibilities of cannibalism in ancient Egypt and hoped that X-raying these human remains would provide supporting evidence (Taconis 2005:43). These bones were removed from the body in antiquity and wrapped separately in linen bandages (Böni *et al* 2004:207). The cannibalism assumption was supported by Petrie's observation of teeth marks on human tissue and missing marrow from long bones discovered at Tomb 5 from Naqada and from other sites such as Gerza (Aufderheide 2003:220). The following year, a mummy and more human remains from the cemetery of Deshasheh were X-rayed and the pictures were published in 1898 (Fig:4.3). In his reports, Petrie did not give any information about the X-ray machine that was used or the location in which the X-ray examination took place (Fiori & Nunzi 1995:68).

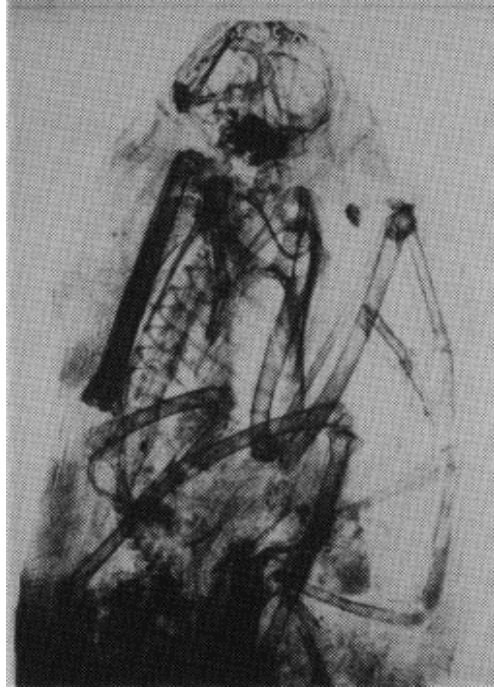


Fig:4.2 Radiograph of the Ibis mummy that was examined in Belgium by Heurck in 1896.
(from Tiggelen 2004).



Fig:4.3 The lower leg and wrapped limbs discovered by Petrie during his excavations at the cemetery of Deshasheh. and their positive X-ray image. Petrie radiologically examined the wrapped limbs at the University College London. The picture illustrates Harris lines in the tibia which appear as radiopaque lines across the bones (Taconis 2005:38).
(right from Petrie 1897:Pl XXXVII) (Left from Adams 1984:17)

One of these radiographs shows Harris lines in the distal end of the tibia (Gray 1967a:34). It seems that Petrie also examined the wrapped remains deposited inside an Egyptian coffin from the collection of the Vienna Museum of Natural History in 1898 (Cosmacini & Piacentini 2008:618). These proved to be animal and not human remains, as originally thought (Cosmacini & Piacentini 2008:618).

In 1897, Albert Londe, the French physicist, published his article *Les Rayons Roentgen et Les Momies* in which he mentioned the examination of an Egyptian mummified arm (Böni *et al* 2004:205). The X-rays showed a ring on the thumb and the age at death was estimated as 7 to 9 years old. In the article Londe suggested that there was a great future for X-ray technology in the field of forensic medicine (Böni *et al* 2004:205). In these early days of X-rays, the exposure time was extremely long: up to 20 minutes in some cases (Böni *et al* 2004:205). It has been also reported that in 1898, F.J. Clendinnen (1860-1913), an Australian radiologist, X-rayed a mummified hand which showed an unusual number of sesamoid bones (Taconis 2005:43).

Pellegrini reported the first radiographic examination of a mummified fish in 1900 (Vyhnánek & Strouhal 1976:118; Wells 1963a:401). It is also reported that, in 1903, L. Lortet and C. Gaillard used X-ray during their examination of the animal mummies which was published under the title *La Faune Momifiée de l'Ancienne Égypte* (Vyhnánek & Strouhal 1976:118).

In 1903, Elliot Smith (1871-1937) examined the mummy of Thutmose IV, using the only X-ray apparatus in Egypt at that time. Smith, with the help of Howard Carter, transported the mummy in a horse-drawn cab to Dr. Khayat at his private medical facility in Cairo (Smith 1912c:45; Taconis 2005:43). Smith was interested in using the new technique to estimate the age at death of the king. From the “*skiagrams*”, Smith was able to study the texture of the bones and the epiphysis of the scapula on the vertebral side which was fused. After examining the X-rays, Smith was able to estimate the age at death as not more than 28 years (Smith 1912c:45). In 1907, *The Lancet* reported that Smith spent three years examining forty four mummies from Deir el Bahari that date back to the Twenty First Dynasty and were discovered in 1891 (Anonymous 1907:1627). In 1912, Smith published his significant study of the royal mummies in the Egyptian Museum, Cairo, which had been unwrapped previously by Maspero, Brugsch and Smith himself between 1881 and 1905 (Seipel 1996:41).

In 1905, Ernst Albers-Schoenberg (1865-1921) published an article about the X-ray examination of two mummies from Egypt. One of the aims of his research was to establish if there were any human remains inside the linen wrappings (Böni *et al* 2004:208). His observation on one of the mummies, which belonged to a priest of Amun from the collection of the Ethnographic Museum of Hamburg, highlights the essential role of X-rays in the examination of mummification techniques (Böni *et al* 2004:208).

A few years later (1913), Bertolotti, the Italian radiologist, investigated the mummy of a child dating to the 11th Dynasty and discovered an extra lumbar vertebra in its spinal column (Taconis 2005:43; Seipel 1996:41; Cosmacini & Piacentini 2008:618). Bertolotti was originally interested in using the X-ray technology to find amulets and jewellery within the wrapped mummies (Taconis 2005:43). His article *Une Vertèbre lombaire surnuméraire complète chez une momie égyptienne de la XI^e dynastie* which was published in Paris marks the beginning of radiopathology (or paleoradiology) in the study of the mummified remains (Seipel 1996:41; Taconis 2006:43; Vyhnánek & Strouhal 1976:118).

In 1921, Salomon, a German doctor, published his paper *Roentgenbild eines peruanischen Mumienteils* or *X-ray Photograph of a Peruvian mummy* in Berlin. The mummy, which was discovered at an Inca burial site, is that of a child in the crouched position (Böni *et al* 2004:209). X-ray images of the arm assisted in estimating the age at death at between two and three years, based on the development of the epiphysis of the radius and the metacarpals and the presence of the capitate and hamate in the hand (Böni *et al* 2004:210). In the same year a radiological study of the collection of mummies in the Lowie Museum of Anthropology, California, was carried out but it remained unpublished. The results of this study were stored at the University of California (Brothwell 1969:342).

A portable X-ray facility was used for the first time to examine an Egyptian mummy in the Guimet Museum in Paris in 1924 (Taconis 2005:43). In the same year, the Field Museum of Chicago carried out an X-ray examination of a mummy that dates back to the 26th Dynasty (Ikram & Dodson 1998:96). The mummy collection in the Museum of Fine Arts, Boston, was X-rayed in 1930 resulting in one projection for each mummy (D'Auria *et al* 1992:246).

In 1931, the University of Chicago published the extensive radiological study carried out by Roy L. Moodie, a well known Palaeontologist, on 17 Egyptian mummies, *Roentgenologic studies of Egyptian and Peruvian mummies* (Taconis 2005:43; Tiggelen 2004:13; Anonymous 1929:245). In this publication, Moodie used radiographic images to highlight an unusual case of body manipulation. The body which belonged to a child, was bigger than the available coffin so the embalmers discarded the arms from the shoulders and a large portion of the legs in order to fit the body into the coffin (Fig:4.4) (Gray 1966:138). This study included mummies from the American Museum of Natural History in New York, the Field Museum of Natural History in Chicago, the University of California, and the San Diego, Museum and was reported in *Modern Mechanics and Inventions* magazine in November 1928 and in *The Science-Newsletter* in October 1929. An earlier publication by Moodie in 1923 highlights his interest in using radiography to study the evidence of ancient disease which made him a pioneer in the field of palaeopathology (Vyhnánek & Strouhal 1976:118). In 1938, Moodie published life size radiographic images of one of the mummies in the Field Museum of Chicago (Tiggelen 2004:11).

The following year (1932), Douglas Derry (1874-1961), the anatomist who examined the mummy of Tutankhamen with Howard Carter, realised the importance of radiography in the study of mummies. He X-rayed a number of mummies including those of Amenhotep I and Tutankhamen, which showed several abnormalities (Taconis 2005:43; Seipel 1996:42, Hirata 2005:259). Derry was initially interested in discovering the position of the arms of Amenhotep I. He compared it with the mummy of Tuthmosis I in the hope that this might help to solve its identification problem. The X-ray images confirmed that the mummy of Amenhotep I bore evidence of disturbance by the ancient tomb robbers before it was rewrapped during the 21st Dynasty (Harris & Wente 1980:XV). The X-rays also showed an unusual position of the arms; the right forearm is across the chest and the left arm is straight, at the side of the body (Harris & Wente 1980:171).

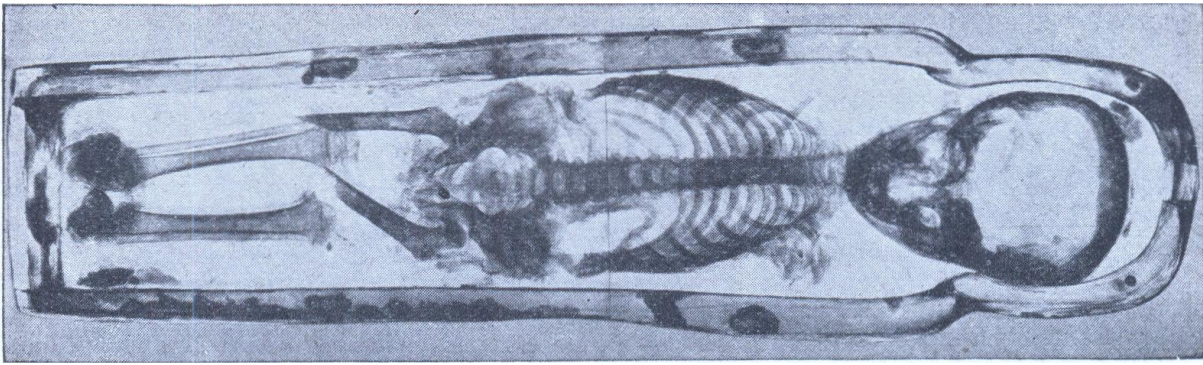


Fig:4.4 X-ray of the mummy of the child Tediumun showing missing arms and broken joints in order to fit the body inside the small coffin.

(from Modern Mechanics and Inventions Nov. 1928)

http://blog.modernmechanix.com/mags/ModernMechanix/11-1928/mummy_xrays.jpg

(Accessed on 1/2/2011)

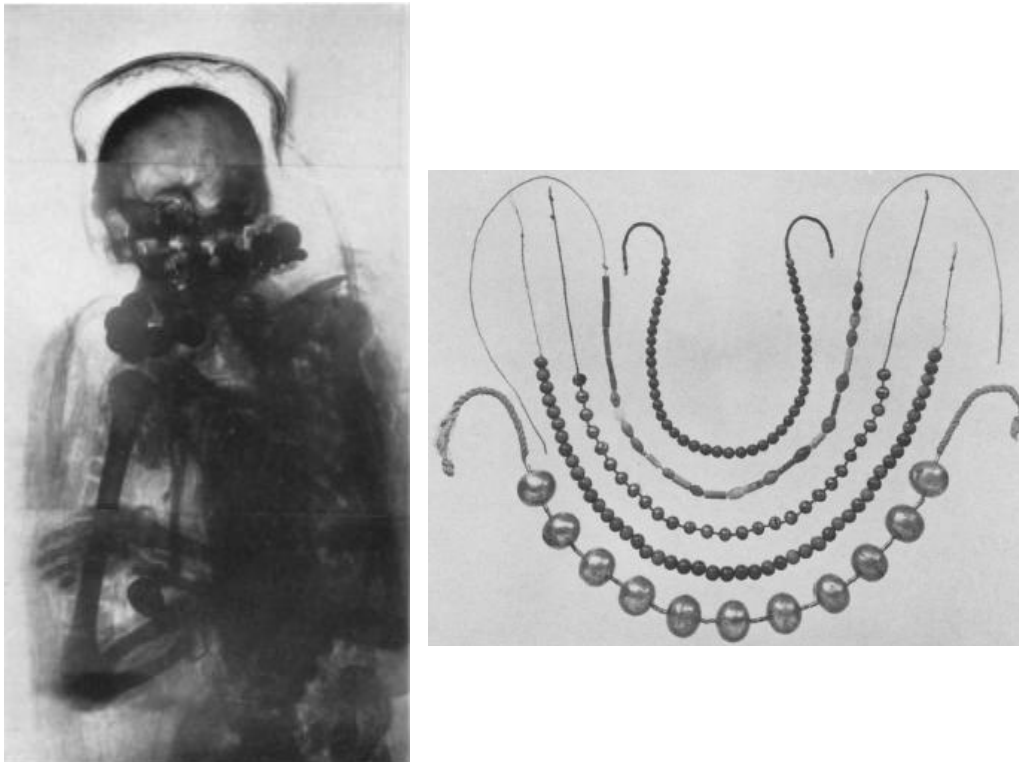


Fig:4.5 X-ray of the upper part of the mummy of Wah showing the various pieces of jewellery within the mummy. The image on the right shows the necklaces that appeared previously in the X-ray images after they were retrieved from the mummy.

(left from Winlock 1936:276) (right from Winlock 1940:257)

In 1936, H. E. Winlock (1936:274) published the results of the examination of the intact mummy of Wah (MMA 20.3.203) in the Metropolitan Museum of Art which dates back to the Middle Kingdom. The Mummy was discovered together with few simple funerary artefacts in a small tomb by Winlock in 1920 (Winlock 1940:253). The mummy was on display at the Metropolitan museum for 15 years as an example of an intact wrapped mummy while the other mummies that Winlock suspected would include jewellery or amulets were unwrapped (Winlock 1940:253). David Rosen (probably a conservator) and Arthur Kopp (chemist at the museum) suggested using a portable X-ray machine to examine the mummy without disturbing the wrappings (Winlock 1936:274). To Winlock's surprise, the images showed a large amount of jewellery and amulets within the wrappings (Fig:4.5) which later encouraged him to unwrap the mummy, retrieve the jewellery and rewrap the mummy again (Winlock 1940:253). Paleopathological examination of the images was carried out by Dr. Kaplan, Dr. Jaffer and Dr. Ramirez who suggested that the mummy was that of a male who had suffered irritation in his feet for a long time. Healed fractures in the feet were also detected in addition to local fragmentation of the right tibia which is known as Osgood Schlatter disease (Winlock 1936:275).

In 1942, Jonckheere, a Belgian surgeon, published his accounts of the autopsy of the mummy alleged to be that of Boutehamon, the royal scribe²¹ from the collection of the Brussels Royal Museum of Arts and History in *Autour de l'autopsie d'une momie. Le scribe royal Boutehamon* (Tiggelen 2004:12). Assisted by the radiographic images, Jonckheere identified two post-mortem fractures in the shoulder and the arm and estimated the age at death to about 50 years old (Tiggelen 2004:12).

²¹ It has been proven that the mummy in the coffin is an intrusive body and it does not belong to Boutehamun, the owner of the coffin. The mummy was put in the coffin at a later date (Taylor 2007:Per.com.).

In the 1960s, the efforts of P. H. K. Gray, the British radiologist and physician, pushed the radiological studies of Egyptian mummies a long way forward (Seipel 1996:42). He carried out a large radiological survey on mummies from the collections of many museums in the UK and Europe, using portable X-ray equipment (Gray 1967a:34; David 2000:375). This survey started with the examination of the mummy of Pa-er-Abu, a young male from the Haslemere Educational Museum, and the results motivated Gray to carry out the survey and examine more than 190 mummies from different museums around the world (Gray 1973:51). The aim of this survey was to establish if the wrapped mummies contained any human remains or modern fakes. If they were found to be genuine, estimation of age at death and gender were established (Gray 1967a:34). The age of death of most of the mummies from this collection was below 40 years which could be a result of spinal arthropathy as suggested by Gray (1973:52) and Strouhal and Vyhnánek (1976:128).

The cause of death was not established for any of the mummies studied by Gray but interesting cases such as the presence of gall stones were detected during the examination of the radiographs (Gray 1973:52). Evidence of malignant neoplasia, syphilis, tuberculosis, leprosy and rickets was never detected during this survey (Gray 1973:53). Differences in mummification techniques and disease were observed as well as the presence of any jewellery or amulets within the wrappings (Gray 1967a:34). Gray was also hoping to establish an accurate and reliable dating method by examining as many mummies as possible from different collections (Gray 1967a:41). One of the important studies that was carried out jointly by Gray and Dawson is the examination of the collection of mummies in the British Museum (78 mummies). In 1968, the results of this study were published in the *Catalogue of Egyptian Antiquities in the British Museum, I. Mummies and Human Remains*. Investigation of other mummies from the same collection was carried out by Filer in the 1990s (Filer 1995:46).

In one of Gray's publications, he highlighted the use of radiographic examination in the detection of restorations occasionally made by the embalmers, who added artificial limbs to the mutilated body (Gray 1966:138). In 1964, Gray examined two mummies from the collection of the Hancock Museum (Newcastle upon Tyne), using portable X-ray equipment (Gray 1967b:75). The first one, the Denon mummy, was unwrapped in 1830 by a team of surgeons and found not to be eviscerated through the usual left flank incision but an attempt

to eviscerate *per anum* had been carried out by the embalmers (Gray 1967b:77). The mummy probably dates back to the 26th Dynasty and the radiographs did not show any evidence of disease or pathological conditions (Gray 1967b:77).

The second one, the Coates Mummy (*Museum reg. no. Aregypt 605*), was acquired by Thomas Coates in 1820 who presented it to the Newcastle Literary and Philosophical Society in 1821 (Gray 1967b:77, Watson & Myers 1993:179). In 1822, a letter was sent to the editor of the Newcastle magazine urging the society to unwrap the mummy as soon as possible for the sake of science or it will turn into dust in front of their eyes as the British weather is very different from the dry Egyptian weather that preserved the mummy for thousands of years (Anonymous 1822:152). The letter contains the rhetorical question:

“What object (does) the society intend to fulfil by allowing it (the mummy) to remain untouched?” (Anonymous 1822:154).

Apparently the society did not follow that advice and preferred to keep the mummy untouched which gave Gray the opportunity to examine it in 1964.

The radiographic examination of the mummy which belonged to a Theban lady called Baketen-her-nakht showed the subcutaneous packing in the neck and the upper legs in addition to the presence of the separate packages of internal organs which were replaced inside the body by the embalmers (Gray 1967b:78, Watson & Myers 1993:180). According to this information Gray suggested that the mummy dates to the 21st or the 22nd Dynasty (Gray 1967b:78) but more recent examination of scenes depicted on the cartonnage case of the mummy narrowed the dating to the 22nd Dynasty (Watson & Myers 1993:179).

In 1968, Gray examined the mummy collection of the Horniman Museum, Forest Hill, London, and reported two cases of bone infarction in the lower extremities of the two Egyptian mummies (Gray 1968:436). In another publication, Gray reported a case of *osteogenesis imperfecta* in a child's mummy that was discovered by Garstang in the cemetery of Beni Hassan, Middle Egypt (Gray 1969:106). The mummy, which was found in a 22nd Dynasty tomb, is now in the collection of the British Museum (Gray 1969:106). The X-rays of the remains, showing the deformed teeth and long bones, have suggested the diagnosis as *osteogenesis imperfecta* in association with *dentinogenesis imperfecta* (Gray 1969:108).

In 1961, Simon and Zorab (1961:386) examined seven Egyptian mummies from the collection of the British Museum. The main aim of this study was to detect cases of ankylosing spondylitis (Simon & Zorab 1961:386). Alkaptonuria which is a rare genetic disorder was detected through the radiographic examination of the vertebral column of a female mummy dating to the Roman Period (Simon & Zorab 1961:384). This case is associated with inbreeding and therefore detecting such rare disease while examining such a small sample could indicate a high degree of inbreeding amongst the ancient Egyptian population (Wells & Maxwell 1962:679). To confirm Simon and Zorab's findings, Wells and Maxwell (1962:679) examined two mummies from the Castle Museum, Norwich. The first mummy was X-rayed before a partial autopsy was performed. The results of this examination suggested a possible diagnosis with Alkaptonuria, also known as Ochronosis (Isherwood *et al* 1979:37), but the histological examination did not support this diagnosis (Wells & Maxwell 1962:680). They searched for any reference to the symptoms of Alkaptonuria in ancient Egyptian medical papyri but this also could not be found (Wells & Maxwell 1962:681). However, the diagnosis of Alkaptonuria from the radiographic images of a second mummy from the same collection was inconclusive (Wells & Maxwell 1962:682). Vyhnánek and Strouhal (1976:126) and Isherwood *et al* (1979:37) suggested that the opaque intervertebral discs represent changes to the body structure caused by the mummification process, probably due to the use of the natron salt or resin as in the case of mummy 1770 which was confirmed by the Manchester team during the unwrapping of the mummy (Isherwood *et al* 1979:37). This falls into the category of pseudopathological observations, especially with the absence of any other symptoms associated with Alkaptonuria such as osteoarthritic lipping and/or narrowing in the articulation surface of the hip or knee joints (Isherwood *et al* 1979:37; Stenn *et al* 1977:566). Isherwood *et al* (1979:37) reported that X-ray images showed 10 cases from the Manchester Museum mummy collection with opaque intervertebral discs, most probably due to mummification procedure.

The earliest confirmed case of Alkaptonuria is the mummy of Harwa, 22nd Dynasty²², from the collection of the Field Museum, Chicago (Fig:4.6) (Stenn *et al* 1977:566). Radiographic examination showed opaque intervertebral discs as well as narrowing of the articulation surface of both the knee and hip joints (Stenn *et al* 1977:566). Biochemical analysis of

²² Based on the style of the coffin, the mummy and the cartonnage of Harwa should be dated to the 26th Dynasty (Taylor 2011:Per. Com).

samples from the right hip was carried out and homogenetic acid pigmentation typical to Alkaptonuria was detected confirming the diagnosis (Stenn *et al* 1977:566). It is interesting to note that Alkaptonuria was not detected during an earlier examination of Harwa that was carried out in 1941 when the mummy was on loan to be on display in the Hall of Egyptian Archaeology as part of the New York World's Fair (Martin 1941:388). Harwa was the first mummy to be radiographed daily during an exhibition as the display included a special fluoroscopic screen that showed a radiographic image of the full mummy to the public every 40 seconds (Fig:4.7) (Martin 1941:386).

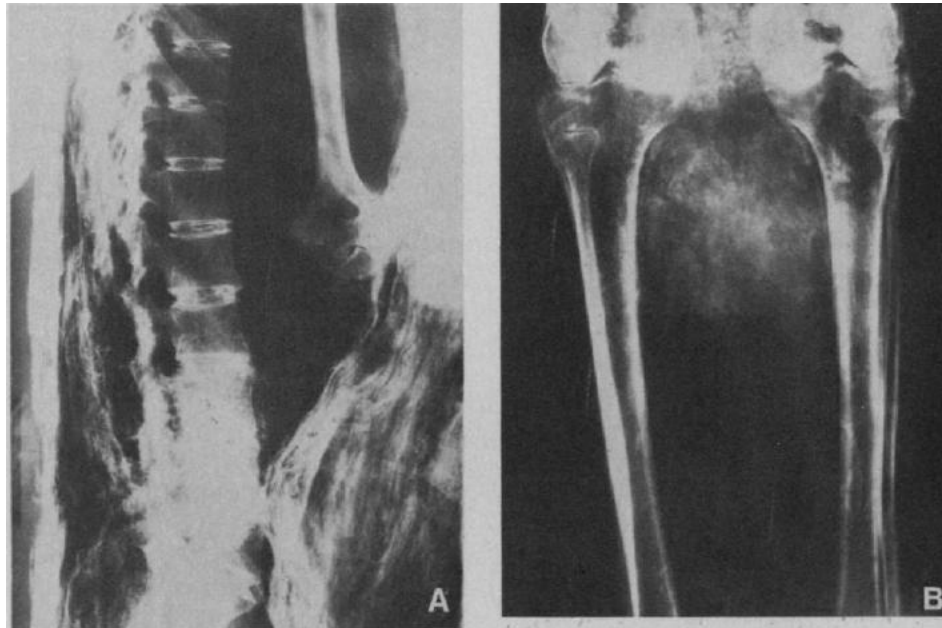


Fig:4.6 X-ray images of the mummy of Harwa, Field Museum, Chicago.
(from Stenn *et al* 1977:566)

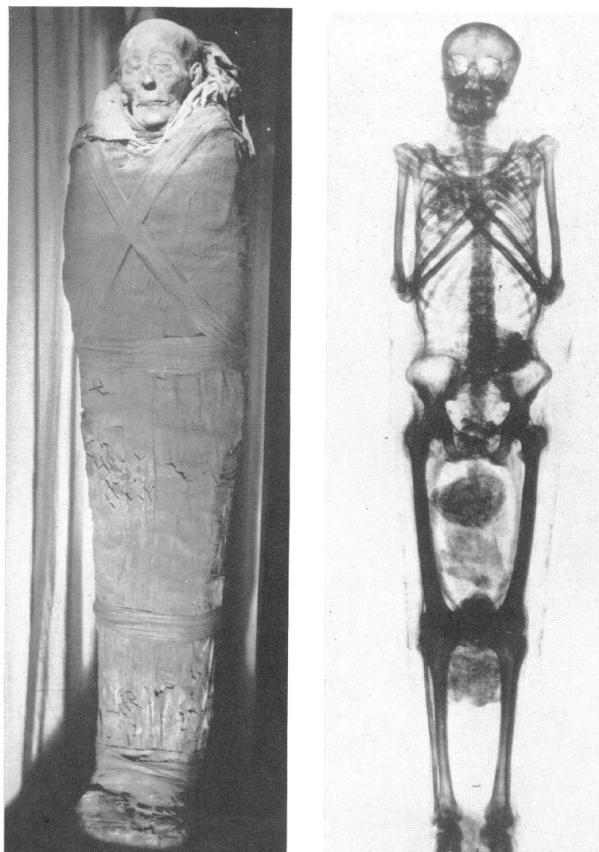


Fig:4.7 The mummy and X-ray image of Harwa, 22nd Dynasty, during
the Fluoroscopic examination at the New York World's Fair.

(from Martin 1941:387)

In 1963, Brothwell published a radiographic image which highlighted the importance of X-rays in the field of the history of medicine. He examined a forearm that dates back to the 9th Dynasty from the collection of the British Museum (Natural History) (Brothwell 1963:192). The hand and distal ends of the ulna and radius had been lost during the lifetime of the deceased. The remaining bones are fused together at the end of the fragments indicating amputation and healing during life (Brothwell 1963:192). Brothwell also discussed a wide range of possibilities for the amputation which included surgical treatment of an infected hand (Brothwell 1963:193).

In the same year, 1963, Professor R. G. Harrison, Professor of Anatomy in the University of Liverpool, together with a team of scientists, examined the skeletal remains that were found in Tomb KV55 in the Valley of the Kings (Harrison 1966:95). Harrison (1966: 95-119) published the radiographic study of these remains which not only eliminated the possibilities of hydrocephalus or pituitary disorder as previous studies of the bones suggested but also highlighted the usefulness of the radiographs in the estimation of age at death and the genealogical relationship between members of the same family (Harrison 1966:111,114).

In 1968, Harrison X-rayed Tutankhamen's mummy and one of the mummified fetuses that was found in the same tomb. Harrison and Abdalla published an article entitled "The remains of Tutankhamun" in 1972 where the results of the radiographic examination were discussed (Harrison & Abdalla 1972:8-14). A 1930s portable X-ray machine was used to examine the skull of Tutankhamen, as the Egyptian authorities did not give permission for the team to transfer the mummy to a hospital in Luxor. Interestingly, the team used their hotel bathroom as a photographic laboratory to develop the test exposure films but the main films were developed in Liverpool (Harrison & Abdalla 1972:10). The X-ray images showed a fragment from the cribriform plate of the ethmoid bone inside the skull which confirmed that the brain was extracted through the nose (nasal excerebration) (Harrison & Abdalla 1972:11). This highlights the value of radiographic examination in the study of the mummification techniques. The stature of the king was also estimated from measurement taken from the X-ray images (Harrison & Abdalla 1972:11).

Concerning the mummified still-born foetus which was stored in the Department of Anatomy, Cairo University, Harrison pointed out a number of significant abnormalities that were detected in the radiographic images (Harrison *et al* 1979:19). Harrison *et al* (1979) reported the earliest known case of Sprengel's deformity which was detected during the X-ray examination of the foetus.

Meanwhile, J. E. Harris and K. Weeks were carrying out the radiological study of the Royal Mummies in the Egyptian Museum in Cairo, which lasted for five years from 1966 until 1971²³ (David 2000:375; Seipel 1996:42). The study, which was focused more towards dental examination, was conducted by a team from the University of Michigan and Alexandria University and sponsored by the Public Health Service in the United States (Harris & Wentz 1980:XV). During this examination, mathematical calculations based on the X-ray images of the skulls of the kings and queens was used to establish and produce kinship charts of the Egyptian dynasties from the late 17th Dynasty till the 21st Dynasty (Harris & Weeks 1973:42). Whitehouse (1980) (Fig:4.8) contributed to this publication a study of the radiological findings of disease processes in the royal mummies such as ankylosing spondylitis which was observed in the spine of Amenhotep II (Whitehouse 1980:292). Ankylosing spondylitis was diagnosed in 1967 by Bourke from two vertebral columns discovered by Petrie in 1901 (Bourke 1967:357). Radiographs of the spine showed the characteristic variations associated with ankylosing spondylitis (Bourke 1967:359). The findings of the Michigan team regarding the ages at death did not correspond with archaeological evidence and which created uncertainty about the identification of the royal mummies. More research is needed regarding this issue.

²³ During the archaeological survey in Nubia before the construction of the High Dam in 1965, Harris and Weeks used radiographic imaging to investigate more than one thousand Nubian skulls using radioactive sources (Taconis 2005:46).



Fig:4.8 Professor Whitehouse examining the X-ray radiographs of Tuthmosis I at the University of Michigan Medical Center.
(from Anonymous 1971:245)



Fig:4.9 A panoramic view obtained using the radioactive isotope, Iodine 125 to examine the teeth of the mummy of Tutankhamun.
(from Leek 1971:pl XXX)

In 1969, T. Burton-Brown, the curator of the Egyptian Department at Manchester Museum, together with a team of radiologists, examined a few mummies from the museum's collection using portable X-ray equipment and the results which were briefly published showed some evidence of arthritis, gallstones and fractures (Anonymous 1969:97). In the same year, 1969, Delorenzi and Mancini carried out a radiological survey on 20 mummies from the Egyptian Museum in Turin (Delorenzi & Mancini 1973:49). The examination was undertaken using portable X-ray equipment and jewellery was found in 3 mummies. The radiographs allowed observation of different mummification techniques and pathological cases (Delorenzi & Mancini 1973:49).

In 1970, Gray examined a mummy in the Museum and Art Gallery at Truro, Cornwall. He pointed out the damage caused to the mummy during and after the process of unwrapping and the resulting loss of information, especially as it was not recorded scientifically and in sufficient detail (Gray 1970:134). In his radiographic examination of this mummy, Gray was able to observe and investigate the mummification techniques that were used and he dated the mummy to the end of the 21st Dynasty²⁴ (Gray 1970:134).

Two mummies, dated to the Roman Period, from the Egyptian section at the Royal Museum of Arts and History in Belgium, were studied in 1970 by P.A. Janssens (Tiggelen 2004:12). He also examined a mummy which probably belongs to Nesikhonsu, singer of Amon-Re of the 21st Dynasty from the same collection (Tiggelen 2004:12). In 1971, Leek (1971:105) reported the use of the radioactive isotope Iodine 125 to examine the teeth and skull of the mummy of King Tutankhamun (Fig:4.9). After a long period of exposure, 3 hours, the radiographs showed a panoramic view of the teeth and a detailed image of the sutures which helped in aging the mummy (Leek 1971:108).

²⁴ On the other hand, the evidence from the coffins suggests that it should be dated to the 25th Dynasty (Taylor 2011:Per. Com).

In 1973, an interdisciplinary team was formed and directed by Professor Rosalie David, then the curator of Egyptology in the Manchester Museum (Seipel 1996:42). The Manchester Mummy Project is considered to be a significant step forward in the progress of the scientific study of mummies. One of the objectives of this project was to study the collection of human and animal mummies in the Manchester Museum (about 21 human mummies and 34 animal mummies representing a range span of more than 3000 years of Egypt's mummification history) (David 2000:375; David 1985:42). The Manchester Project focused on detecting evidence of abnormality and disease, establishing the age and cause of death if possible and obtaining information about diet, environment, living conditions, and religious and funerary customs of the ancient Egyptians (David 1985:43; Seipel 1996:42). Another and more important aim of this project was to establish a standardised method or manual for the scientific investigation of the mummified remains (David 1985:43; Seipel 1996:42). The mummies were transferred to the Manchester Royal Infirmary where they were X-rayed and studied using different techniques including fluoroscopy (David 2000:375). The results of this study were published in 1979 adding a new dimension to mummy research. The use of facial reconstruction to visualise the appearance of the mummified deceased during life was also produced by Neave from the X-ray radiographs (Seipel 1996:42; Lynnrup 2010:443).

In 1974, X-ray examination was used together with histological investigation to diagnose an ulceration of a mummified leg from a private collection in the Netherlands (Haneveld 1974:103). Further examination was needed to decide the cause of the ulceration (Haneveld 1974:106). The X-rays showed osteoporosis in the fibula and periosteal reaction or osteophytes between the tibia and the fibula in addition to a calcification in the arteries (Haneveld 1974:103).

In 1975, the next step for the Manchester Mummy team was to perform a scientific autopsy of a badly preserved mummy from the collection of Manchester Museum. The team also organised the first international conference on *Science in Egyptology* in June 1979, established an international mummy data bank and a mummy tissue bank (Seipel 1996:43). The Manchester team continues to lead the way forward in mummy research and organised the second *Science in Egyptology* conference. The papers from the two symposia were published in 1986 (Seipel 1996:43).

An ancient Egyptian skull was radiographically examined by Strouhal in 1976 to support the diagnosis of a soft tissue tumour that left its mark on the bone (Strouhal 1976:613). In 1978, following in the footsteps of David and her team, the collection of Egyptian mummies in the Bristol City Museum was studied and X-rayed and in 1981, an autopsy was performed on a poorly preserved mummy from this collection (Taconis 2005:45).

The interest in mummy research that was generated in Manchester also had its impact in Europe. The collection of mummified humans and animals in the Czechoslovak Museums were investigated by Strouhal and Vyhnánek in 1971 (Strouhal & Vyhnánek 1976:114-118). During this investigation, mummification techniques were observed and studied from the X-ray images and were used to date the mummies accurately (Strouhal & Vyhnánek 1976:115). These dates were also compared to the historical dating of the coffins which was proved to be correct in many cases. Age at death was estimated for all the 99 human mummies and remains and it was concluded that mortality levels increase significantly for both men and women after 30 years of age (Strouhal & Vyhnánek 1976:117). They also highlighted the importance of collaboration between Egyptologists and radiologists during the examination of X-ray images of mummies as only a multidisciplinary team would produce accurate and reliable results (Strouhal & Vyhnánek 1976:119).

As the Manchester team established the interdisciplinary approach to the investigation of mummies, a similar team examined the mummy of Ramesses II in Paris in 1976 (Taconis 2005:45). The detailed results of this investigation were published in 1985 (Seipel 1996:43). The age at death was established from the radiographic and Xeroradiographic images of 80+ years which was supported by historical evidence and several age-related pathological observations such as osteoarthritis, atherosclerosis and ankylosing spondylitis (Seipel 1996:43; Taconis 2005:45). The dental examination of this mummy revealed a wide range of dental diseases (Taconis 2005:45). A recent radiographic study revealed the existence of the same feature in the mummies of Ramesses II, his son Merenptah, Thutmosis I and Amenhotep II (Feldtkeller *et al* 2003:5). Chhem *et al* (2004) re-examined the published and the unpublished radiographs, and argued that the radiographic images of Ramesses II do not support the diagnosis of ankylosing spondylitis. They suggested that the king could have suffered from diffuse idiopathic skeletal hyperostosis or DISH (Chhem *et al* 2004:216). They

also recommended the use of computed tomographic scans to confirm the condition from which the king suffered²⁵ (Chhem *et al* 2004:211).

One of the major advances in the scientific study of Egyptian mummies was accomplished by Aidan Cockburn who directed an interdisciplinary team that carried out a series of autopsies in Detroit, Philadelphia and Toronto (Taconis 2005:46). Cockburn and his team were described by Angel and Zimmerman (1982:122) who were members of this team as “*amateurs*”. The team can also be described as international as it included members from American, British, Canadian, and Czech institutions (Cockburn *et al* 1975:1160). Cockburn formed this team to perform scientific autopsies on mummies such as the mummy from the collection of the Detroit Institute of Art (DIA I).

In February 1973 a symposium entitled *Death and Disease in Ancient Egypt* was held in Detroit, Michigan (Cockburn 1973:470). A mummy, PUM II, on loan from the Pennsylvania University Museum was unwrapped and examined as part of the seminar (Cockburn *et al* 1975:1155). This was the third mummy to be autopsied by Cockburn and the team following PUM I and DIA I (Cockburn *et al* 1975:1155).

PUM II was originally part of the Pennsylvania Museum of Art Collection and in 1934 it was sent to the Pennsylvania University Museum as a long term loan (Angel & Zimmerman 1982:122). Cockburn corresponded with O'Connor, the curator of the Pennsylvania University Museum who agreed to send the mummy to Detroit for the Autopsy (Cockburn *et al* 1975:1160). The autopsy took place at the Department of Physiology, Wayne State University School of Medicine, Detroit, Michigan (Lawrence 1980:362). A hammer and a chisel were used to get through the hard resinous layers during the 8 hour mummy unwrapping which was carried out before the start of the symposium (Cockburn 1973:470). Radiographic examination was carried out before the autopsy to assist in the process of choosing the perfect candidate for the unwrapping as two other mummies were available (Cockburn *et al* 1975:1155). X-ray images showed that the deceased suffered from osteomyelitis in the right fibula which caused a deformation of the leg (Cockburn 1973:470).

²⁵ Further discussions on this matter can be found in Russell, A. S. (2004) “Ankylosing Spondylitis or DISH in ancient mummies” *CARJ* (55)5:335 and Chhem, R. K; Schmit, P.; Fauré, C. (2004) “Ankylosing Spondylitis or DISH:reply” *CARJ*, (55) 5:335.

After the autopsy of the mummy, radiographic investigation was also used to examine several pathological features and skeletal abnormalities such as the extra lumbar vertebra in the back and the detection of Harris Lines in the long bones (Cockburn *et al* 1975:1155-1157). Cockburn also pointed out a common mistake when diagnosing skull fractures from the X-ray images of mummified specimens. He mentioned that during the application of the molten resin which is a radiopaque substance, it usually fills the shallow scratches on the surface of the skull. These lines that appear in the radiographic images could be mistakenly diagnosed as fractures (Cockburn *et al* 1975:1155). It is also important to note that Xerographic examination of this mummy was carried out for the first time in 1973 by Wolfe as part of this autopsy in addition to X-ray radiography (Cockburn *et al* 1975:1155, Reyman 1998:354). The formation of the Paleopathological Association and its journal was one of the major outcomes from this seminar (Cockburn 1973:471). Following the autopsy, a scientific based exhibition of the mummy was organised by the Smithsonian Institution in 1974 before it was re-loaned to the Pennsylvania University Museum for another exhibition in the 1980s (Angel & Zimmerman 1982:122).

In 1974, Cockburn who worked for the Department of Anthropology of the Smithsonian Institution at that time carried out another autopsy on a mummy, dating to the 20th Dynasty, from the collection of the Royal Ontario Museum, Toronto (Hart *et al* 1977:461). The mummy which is known as Nakht, a 16 year old boy, was X-rayed before the unwrapping (Hart *et al* 1977:461). Xeroradiographic and tomographic images were also obtained before the autopsy (Rideout 1977:464). The radiological examination showed that Nakht suffered from serious illness during the last two years of his life, as Harris Lines were detected in the images which also showed that remains of the liver and lung tissue were still in the body (Rideout 1977:464). The age at death and the sex of the mummy were assessed from the X-rays, which also showed the absence of evidence for mummification; the body was preserved by natural dehydration (Rideout 1977:464). The results of the studies carried out by Cockburn and his team were published in 1983 in *Mummies, Disease and Ancient Cultures* (Seipel 1996:43).

In 1978, Cuenca published his report on the radiological examination of the collection of human and animal mummies in the Archaeological Museum of Madrid. Cuenca mentioned that a special “bed” was built and used to handle the mummies to prevent damage to the fragile wrappings and remains (Cuenca 1978:101). In 1980, the Pennsylvania University Museum in preparation for their exhibition “*The Egyptian Mummy; Secrets and Science*”, X-rayed the mummies of Hapi men and Djed hapi (Fig:4.10) together with Pum II which was previously studied by Cockburn and his team in 1973 (Lawrence 1980:362).

In 1984, the University of Manchester organised the second international symposium entitled “*Science in Egyptology*”. This symposium and its resulting publication are considered to be a landmark in the scientific study of mummies. The publication includes a study that was carried out in Munich on complete and incomplete human and animal mummies (Parsche & Ziegelmayer 1986:81; Taconis 2005:46) and an examination that was undertaken by a team from the University of Melbourne on a mummy from the Middle Kingdom (Seipel 1996:43). During the Symposium, Neave (1986:329-336) reported the possibility of employing clinical craniofacial techniques which were developed for reconstruction surgery to reconstruct the facial features of wrapped mummies using X-ray images of the skull.

In Paris, Goyon and Josset published their account of the autopsy of a mummy in *Un corps pour l'éternité, Autopsie d'une momie* which took place in Lyon in 1988. The multidisciplinary team used radiographic examination and computed tomography scans to examine the specimen before the unwrapping (Tiggelen 2004:13; Taconis 2005:46). The radiographs showed that the mummy, which was wrapped in sailcloth, was not eviscerated as most of the internal organs were still intact (Hunt & Hopper 1996:15). In 1989, Delorenzi and Grilletto examined thirteen Egyptian mummies from the collection of the Egyptian Museum in Turin (Cesarani *et al* 2003:598). Plain radiography was used during this study and the results were published in a book entitled *Le mummie del Museo Egizio di Torino* (Cesarani *et al* 2003:598).



Fig:4.10 The mummy of Djed Hapi during its radiographic examination at the Hospital of the University of Pennsylvania.

(from Lawrence 1980:363).

In the following years, many of the radiographic studies took place at archaeological sites as a result of the development of portable X-ray equipment, powered by portable generators, which could produce reasonable quality X-ray images (Aufderheide 2003:379). Some researchers prefer the controlled environment of a radiological department as the equipment there is more powerful and the results are more accurate and precise (Vyhnánek & Strouhal 1976:120). Benassi and Ragni (1973:47-48) reported the examination of an Egyptian mummy of an old lady from the collection of the Turin Museum. They used portable X-ray equipment as the investigation had to be done in the museum (Benassi & Ragni 1973:47). The radiographs showed that the mummy suffered from osteoporosis which caused a fracture on her lower right leg that was healed some time before death, in addition to ankylosing spondylitis which was detected at the lower dorsal vertebrae (Benassi & Ragni 1973:48). Reyman (1998:354) mentioned that the interpretation of the X-ray images of the mummies does not come without its own problems, referring to misinterpretations and pseudo-palaeopathology. In 2001, the interdisciplinary investigation of a mummy in the collection of the Archaeological Museum in Cracow in Poland was published by Szymanska and Babraj with one chapter dedicated to the radiological examination of the mummy (Kaczmarek 2001:63-74).

In 2003, Aufderheide published *The Scientific Study of Mummies* which included a full study of both animal and human mummies from different cultures around the world. In 2005, Raven and Taconis published their study of the collection of ancient Egyptian human and animal mummies from the collection of the National Museum of Antiquities at Leiden. This investigation undertaken between 1997 and 2003 included 27 complete mummies, 8 mummified heads and a number of mummy parts. At least 8 complete mummies and one mummified head from this collection date back to the Third Intermediate Period which makes it a very good source of information regarding this particular period and a good reference for comparing results.

4.2 Xeroradiography:

Xerographic examination of PUM II was carried out for the first time in 1973 by John N. Wolfe (Reyman 1998:354). Wolfe reintroduced this technique which was not widely employed since its discovery in 1937 by Chester Carlson (Heinemann 1976:106; Davis *et al* 1977:32). The following year, 1974, Cockburn and his team examined the mummy of Nakht from the collection of the Royal Ontario Museum, Toronto, using the Xeroradiographic techniques before an autopsy was carried out on the mummy (Rideout 1977:464; Millet *et al* 1998:91). The Xerographic images provided evidence to indicate that the damage to the acetabulum area of the pelvis, detected from the X-ray images and diagnosed as a possible protrusio acetabuli or osteomalacia, was due to post-mortem cartilage damage (Millet *et al* 1998:95; Metcalfe 2007:282). This study supported the claims that Xeroradiography could assist in obtaining better diagnostic accuracy and better visualisation of bone and soft tissue details as the edges of the features appear more defined in the images which makes the different shapes easier to identify (Fig:4.11) (Metcalfe 2007:282).

Davis (2007:131) mentioned more advantages of Xeroradiography such as the absence of scattered radiation especially within the voltage range 120-150 KV) usually used for examination of human remains in addition to the edge enhancement, wide exposure range and fine contrast which provide detailed and sharp Xerographic images. In some cases such as during the examination of the mummy of the priest Irethoreru from the collection of the British Museum (EA 20745), a beam hardening filter was added to eliminate the undesirable elements of the X-ray beam in order to produce a clear and detailed image of the amulets within the wrappings of the mummy (Fig:4.12) (Davis 2007:131). Radiological examination of the mummy of Nestawedjat (EA 22812), also from the collection of the British Museum, was carried out using the Xeroradiographic techniques (Davis 2007:136). The sharp images showed clearly the artificial eyes and the winged scarab amulet on her neck (Davis 2007:136).

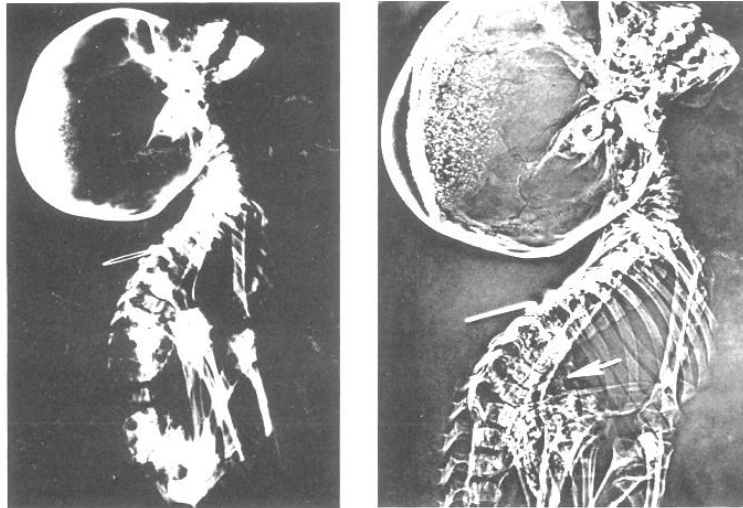


Fig:4.11 Conventional X-ray image (left) and Xerographic image (right) both are lateral views of a Mexican child mummy. The xeroradiographic image shows more detail compared to the conventional X-ray images.

(from Heinemann 1976:107)

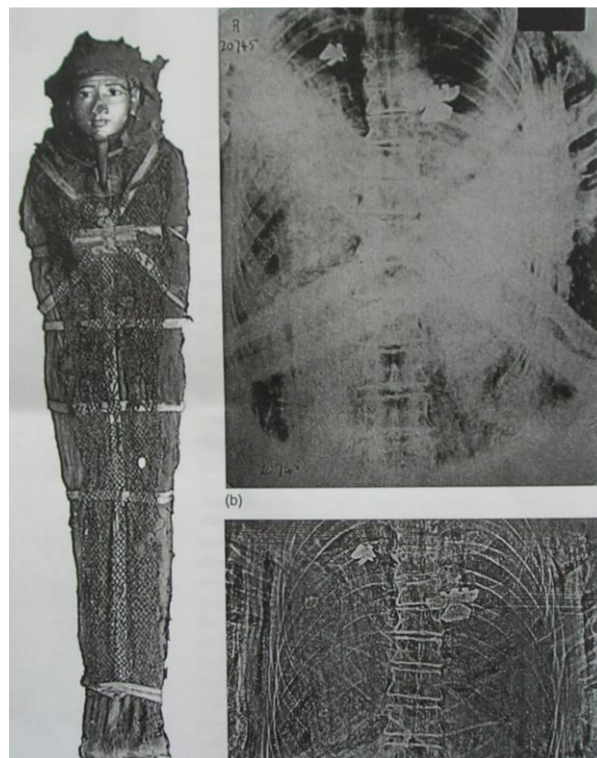


Fig:4.12 The X-ray radiograph of the chest of a Ptolemaic mummy (EA 20745) and the xeroradiograph of the same mummy showing the superior details that can be achieved by using Xeroradiography.

(from Davis 2007:132).

Evidence of embalmer's restoration was documented during Xeroradiographic investigation of an Egyptian mummy from the Ptolemaic Period (EA 29778) (Davis 2007:135-137). A small pottery flask was placed in the thoracic cavity by the embalmer to support the dislocated ribs in addition to a possible rod to strengthen the mummy (Davis 2007:135). In 1976, the mummy of Ramesses II was examined in Paris using a combination of radiographic techniques such as conventional X-ray and Xeroradiography to produce stereographic images of the mummy which were used to determine the age at death (Seipel 1996:43; Davis 2007:133). The Stereoradiographic technique requires the production of two radiographic images of the area of interest from two different angles which can then be viewed as a 3D radiographic image with the aid of a special apparatus or viewer (Davis 2007:133). The beam hardening filter was also used during the Xeroradiographic examination of Ramesses II and the enhanced images showed that the nose was packed with peppercorns and a small animal bone was used to keep the shape of the nose (Fig:4.13) (Davis 2007:113).

In 1979, a study of the dental history of the Manchester mummies was carried out by F.F. Leek as part of the Manchester Mummy Project. Leek (1979:73-74) published 2 xerographic images of the teeth of two mummy heads (no. 22940 (Fig:4.14) and 21475). These images show detailed panoramic views of the teeth including the roots with no superimposition which is always a problem during the dental examination of mummies (Leek 1979:65).



Fig:4.13 Lateral xeroradiograph of the skull of Ramesses II. The fine details of the nose packing are clear due to the use of the beam hardening filter. A small non-human bone is shown to support the nose

(from Davis 2007:133).



Fig:4.14 Xeroradiograph Panoramic image of the dentition of mummy head Manchester Museum no 22940.

(From Leek 1979:74)

4.3 The use of Computer Tomography (CT) Scanning in mummy research:

The first mummified remains to be examined by this method were the brain of Nakht (also known as ROM I), a mummy from the collection of the Royal Ontario Museum that was unwrapped in 1974 by Cockburn and his interdisciplinary team (Taconis 2005:46-48). The remains of the desiccated brain were given to Harwood-Nash, Professor of Radiology at the University of Toronto, and Lewin who carried out the first CT scan investigation in 1975 in the Hospital for Sick Children (Taconis 2005:48; Lewin 1996:10, Huckman 1997:1809). This investigation was not successful. The following year 1976, the brain was re-examined²⁶ (Fig:4.15) and the positive results encouraged Lewin and Harwood-Nash to repeat the same technique on another mummy from the same collection (Taconis 2005:48). This time, Lewin and Harwood-Nash did a full body scan of Djedmaatesankh, a female musician in the Temple of Amun-Re at Karnak from the 22nd Dynasty, and slices 12mm thick showed false eyes and a few amulets within the wrappings (Fig:4.16) (Taconis 2005:48; Harwood-Nash 1979:768). Harwood-Nash reported the results of the study of both the brain and the mummy of Djedmaatesankh in a paper published in 1979 (Harwood-Nash 1979:768-773).

In 1981, Pahl reported the first CT examination of naturally preserved remains. Radiological investigations were carried out on the specimens before they were scanned (Pahl 1981:163). The positive results of this examination were reflected in Pahl's comments on the potential of the CT investigation in the field of mummy research especially for the study of soft tissue and internal organs (Pahl 1981:164). He also mentioned that a combination of radiography and CT scanning would provide a large amount of useful data (Pahl 1981:164). During the 1980s, this technique was used by many European institutes and confirmed its potential in paleoradiology (Taconis 2005:49).

²⁶ In 1977, Lewin and Harwood-Nash published the results of this investigation in an article entitled "X-ray computed axial tomography of an ancient Egyptian brain, *IRCS Medical Science* (5) 78".

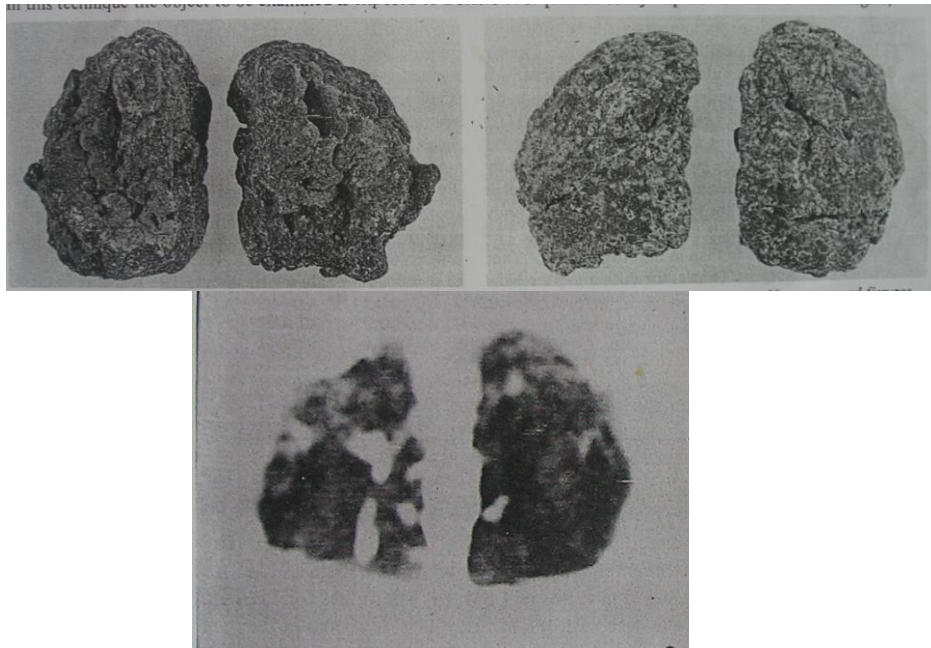


Fig:4.15 The ancient Egyptian brain and the first CT image of an ancient Egyptian human remain.

(from Lewin & Harwood-Nash 1977:78).

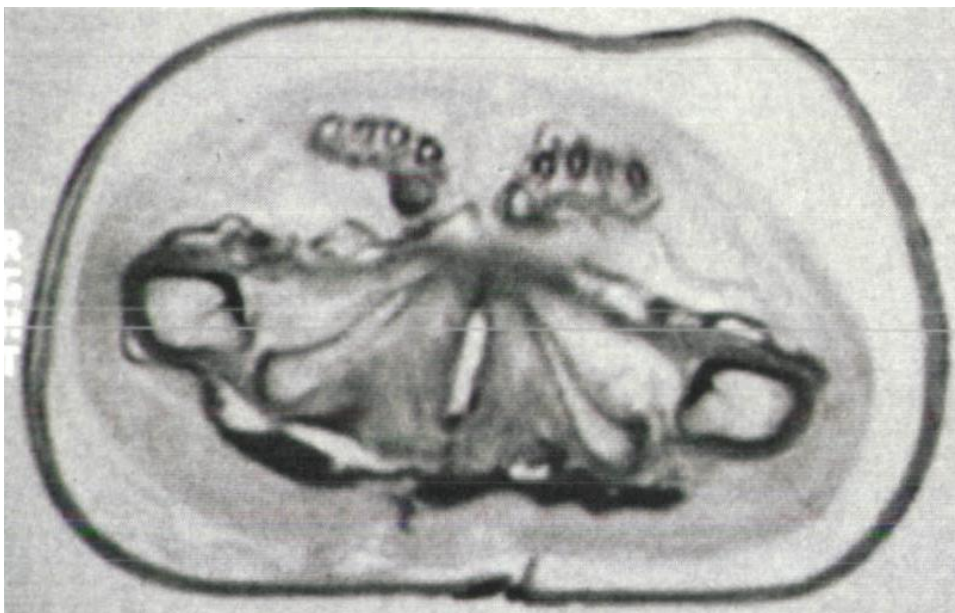


Fig:4.16 CT scanning image of the mummy of Djemaetesankh, 22nd Dynasty, from the collection of the Royal Ontario Museum which is inside a cartonnage case. The images show clearly the layers of linen wrapping and the outline of the cartonnage case. This slice was taken through the pelvis and it shows the location of the hands on top of the pubic ramu.

(from Harwood-Nash 1979:770)

In 1982, Vahey and Brown used a portable CT unit to study a female mummy “Wenuhotep” from the collection of Indianapolis Children’s Museum (Vahey & Brown 1984:992-4). Almost half of the cranial cavity was filled with resin which was detected in the CT scans, and these also showed clearly how the embalmers extracted the brain by fracturing the ethmoid bone (Vahey & Brown 1984:995). The images demonstrated the poor condition of the soft tissues and showed the incision that was used by the embalmers to eviscerate the body, a feature which can assist in dating the mummy. A fracture in the acetabulum, not previously seen in the X-rays, was spotted for the first time in the CT cross-sectional images. The fracture was totally covered with high density resin which is a radiopaque material that obscured the area and hid the fracture (Vahey & Brown 1984:995). In 1990, another examination of the same mummy using three dimensional CT images showed no abnormality in either the femur or the acetabulum (Pickering *et al* 1990:54). The study suggested the presence of a cut in the soft tissue between the pelvis and the femur and that the embalmers could have intentionally introduced embalming fluid into the hip (Pickering *et al* 1990:54).

In 1983, the Minnesota Mummy Project was established to examine Egyptian mummies from the 18th and 25th Dynasties (Notman *et al* 1986:93). The interdisciplinary team carried out full body scans of four mummies in addition to endoscopy, MRI and X-ray radiography (Notman *et al* 1986:93). The study, which was published in 1986, highlighted the importance of CT scanning as an essential tool for examining mummified remains, especially the mummies in cartonnage cases (Notman *et al* 1986:93). It also pointed out the difficulty of examining the details of the spine from the X-ray radiographs, especially when the bundles of wrapped internal organs had been replaced in the abdominal and thoracic cavities (Notman *et al* 1986:93). As a part of this investigation, Notman *et al* examined the mummy of Tashat, a fifteen year old Egyptian female mummy, and reported an additional adult male skull which was found on Tashat’s legs (Aufderheide 2003:383). The CT images showed damage to the back of the adult male skull which was carefully embalmed and wrapped (Lauber 1992:45).

In 1986, Strouhal published the results of CT examination of 21 preserved Egyptian heads from the Czechoslovak collections (Taconis 2005:49). He pointed out the superiority of the CT scans when compared with the X-ray radiographs, especially in the study of damage

caused by the embalmers while extracting the brain (Taconis 2005:49). In the same year, 1986, Marx and D'Auria reported the results of the CT examination of eleven Egyptian mummies from the collection of the Museum of Fine Arts in Boston (Marx & D'Auria 1986:321). They suggested that conventional radiography can best display fractures, dental problems and disarticulations on the one hand and on the other that CT images can demonstrate the level of preservation and most pathological abnormalities in the mummy (Marx & D'Auria 1986:322).

In April 1987, Lewin and his team presented the first three dimensional images of an Egyptian mummy and a mummified cat during the 14th annual meeting of the Paleopathology Association (Lewin 1988:1249; Lewin 1996:11). The study pointed out the possibility of using these images in non-invasive investigations of wrapped mummies and also in the field of facial reconstruction (Lewin 1988:1249). In 1988, Marx and D'Auria reported a three dimensional CT reconstruction of the mummy of Tabes from the 22nd Dynasty (Marx & D'Auria 1988:148). The 3D images showed clearly the surface of the mummy, the extended evisceration incision and amulets (Marx & D'Auria 1988:149). In 1989, Magid *et al* published a three dimensional image of an Egyptian mummy and noted the great potential of applying advanced computerised imaging techniques in the study of the ancient remains (Magid *et al* 1989:239).

Lewin *et al* (1990) applied advanced CT scanning and developed new reconstruction techniques to produce three dimensional images of a mummified specimen from the Royal Ontario Museum, Toronto (Lewin *et al* 1990:217). In the same year, Pickering *et al* (1990:49-55) re-examined the mummy of Wenuhotep previously CT scanned in 1982 by Vahey and Brown using a portable CT scanner. Three dimensional CT images were produced and showed accurate details of the skull and the facial features of the mummy (Pickering *et al* 1990:55).

In 1991, a CT scanning examination of a mummy from the collection of the British Museum was carried out at St Thomas' Hospital in London (Baldock *et al* 1994:806). The mummy, which belongs to a female from the 22nd Dynasty, was inside a full cartonnage case (Baldock

et al 1994:806). The data from the scan was sent to the USA to be analysed and manipulated by a supercomputer to produce 3D images of the mummy (Baldock *et al* 1994:806).

Some scientists claim that CT scanning has been widely used because it appeals to museum curators more than other invasive methods of examination such as electron microscopy, trace element studies, isotope ratio studies and immunohistochemistry which can provide vital biomedical information. Aufderheide (2003:20-21) mentions that CT scanning provides more anthropological and less biomedical information about the specimen. It has also been reported that different chemical elements sharing the same density would appear the same in CT images (Münnemann *et al* 2007:1341).

Hjalgrim *et al* (1995:329-333) reported the examination of the head of a mummy that was discovered at Hawara and is now at the Carlsberg Glyptotek Museum, Denmark. The CT images of the head were used to produce a 3D model of the skull from resin using laser technology (Hjalgrim *et al* 1995:330). The machine produced the model one slice at a time and it took around 40 hours to produce a complete 1:1 model of the skull including the surface and the internal details. The produced life size model was used to confirm the observations made from the CT images such as the sex and age at death in addition to a post-mortem missing third molar. Hjalgrim *et al* (1995:333) mentioned the importance of this technique which is called Stereolithography to produce skulls that can be used for facial reconstruction especially when it is possible to compare it with the representation of the deceased on the mummy portrait which is the case with this mummy.

The facial reconstruction of this particular mummy from the model of the skull produced by Hjalgrim and his team was reported in 2002 (Wilkinson *et al* 2002:145). The mummy portrait was not shown to the reconstruction team before the production of the facial reconstruction (Wilkinson *et al* 2002:145). The team studied the model to determine its ancestry and found that negroid features are present in the skull (Wilkinson *et al* 2002:145). The result of the facial reconstruction and the mummy portrait were very different and represented two individuals from two different racial backgrounds (Wilkinson *et al* 2002:145). The image of the skull was superimposed on the face of the portrait but no similarities were observed which confirms that the portrait and the mummy belong to two individuals (Wilkinson *et al*

2002:145). This study points to the mistake that was made by the embalmers thousands of years ago by providing the mummy with the wrong portrait (Fig:4.17) (Wilkinson *et al* 2002:145).

A similar study on a Ptolemaic mummy discovered by Petrie at the same cemetery and currently housed at the National Museums of Scotland, Edinburgh was reported in 2000 (Macleod *et al* 2000:85-92). The study which was part of the National Museum of Scotland Mummy Project compared the mummy portrait with the facial reconstruction produced from the skull model based on the CT images of the head (Macleod *et al* 2000:85-92). Striking similarity between the portrait and the reconstruction suggested that the portrait was made shortly after or before the death took place (Macleod *et al* 2000:92).

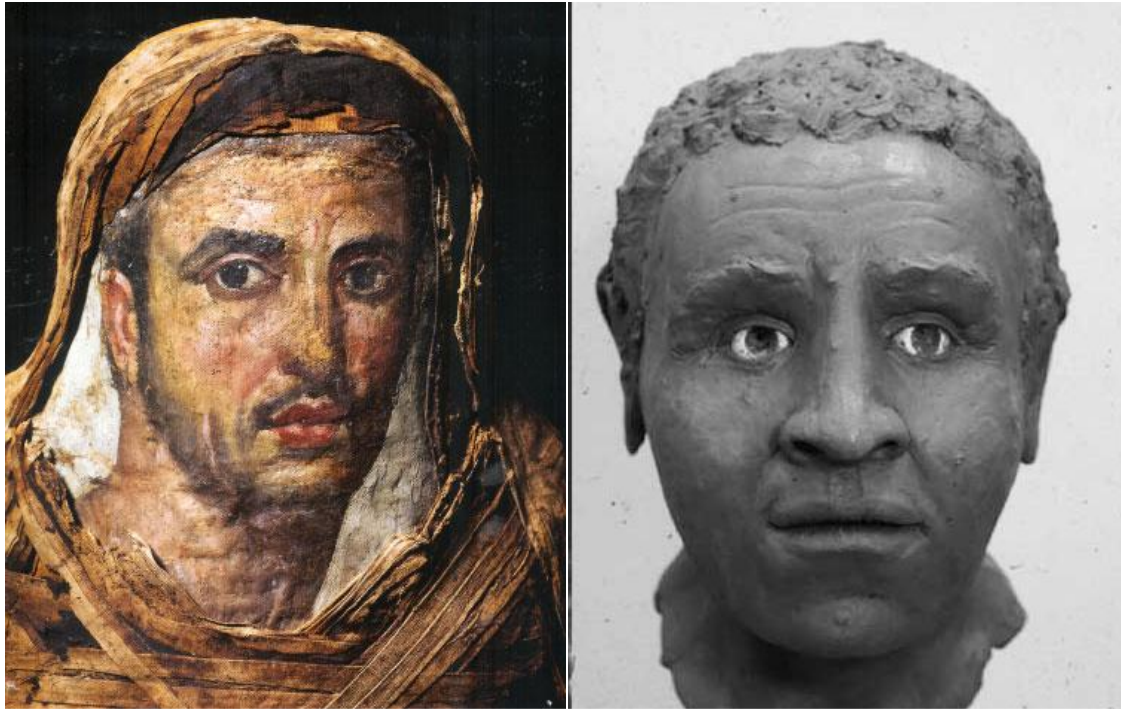


Fig:4.17 Mummy portrait on a Ptolemaic Period mummy from The collection of Carlsberg Glyptotek museum, Copenhagen, Denmark and its facial reconstruction which was based on a stereolithic model of the skull produced according to CT images.

(from *left* Lynnrup 2007:179 and *right* Wilkinson *et al* 2003:144)

In 1991, the mummy of Djedmaatesankh from the Royal Ontario Museum, Canada, was re-examined, 15 years after it was first CT scanned in 1976 (Melcher *et al* 1997:329-340). This research started as a general full body CT scan but later the team decided to focus only on the dentition to demonstrate for the first time that CT images can provide much more information than X-ray radiography (Melcher *et al* 1997:330). During this study, a modified classification of dental attrition was developed as visual examination differs from examining the teeth from CT images (Melcher *et al* 1997:331). The results of this study shed light on the amount of pain that Djedmaatesankh must have suffered during her life because of her teeth, as severe attrition, caries, teeth loss and periodontal disease were observed from the 3D images (Melcher *et al* 1997:339). Based on the severity of dental infection of her teeth it has been concluded that this could have been the cause of death (Melcher *et al* 1997:330).

Rühli and Böni examined two Egyptian mummies from different Swiss collections in 2000. Their aim was to study the post-mortem artefacts that were introduced into the body during mummification such as wrapped internal organs, amulets, artificial eyes, subcutaneous body packing, *etc.* (Rühli & Böni 2000:153). The study was conducted with the aid of plain radiography and Computer tomography (Rühli & Böni 2000:153). The CT images showed clearly the exact location of all the artefacts within each mummy (Rühli & Böni 2000:157).

David T. Mininberg (2001:192-199) examined 15 mummies from the collection of the Metropolitan Museum of Art in New York using a mobile CT unit to study the mummies. The CT images were used to reconstruct the facial appearance of one of the mummies and compare it to its portrait. The resemblance between the portrait and the forensic artist's impression was remarkable (Mininberg 2001:193). The CT images also showed that bones from other individuals were added to the jumbled skeleton of Nesi-Amun to provide some support for the mummy (Mininberg 2001:197).

Hoffman and Hudgins (2002:1367-76) reported the examination of the head and skull base of nine Egyptian mummies from the collection of Michael C. Carlos Museum Emory, USA. The study suggested that the mummification techniques observed in the CT images of an adult mummy could indicate a 19th Dynasty royal identification (Hoffman & Hudgins 2002:1374). The mummy which was later identified as Ramesses I, was presented to the Egyptian Museum, Cairo and it is now on display in the Royal Mummy Room. During this

study Hoffman and his team were the first to use post processing technology to create *virtual fly-through* images of the abdominal and thoracic cavities of the examined mummies (Hoffman *et al* 2002:384).

In 2003, Cesarani and his colleagues published a radiological study that was carried out on thirteen Egyptian mummies from the Egyptian Museum in Turin (Cesarani *et al* 2003:597). The team transported the mummies to the Radiology Department at the University of Turin and used multidetector CT techniques (MDCT) to examine the mummies followed by 3D reconstruction (Cesarani *et al* 2003:598). To obtain high quality images, the minimum thickness of the slices that can be obtained without overheating the X-ray tube which was 2.5mm sections at 1.25 mm intervals were used during this examination (Cesarani *et al* 2003:602). Cross sectional images that show post-mortem fractures, which probably took place during mummification, were reported in a few mummies (Cesarani *et al* 2003:601).

The following year, Cesarani *et al* (2004:755-758) reported the use of Stereolithography to produce a facial reconstruction of Harwa, who lived in Thebes during the 26th Dynasty and died around the age of 45. Harwa's mummy was discovered by Schiaparelli during his excavations in Upper Egypt between 1903 and 1906 (Cesarani *et al* 2004:755). Two models based on the CT images were produced, one was of the skull and the other model represented the soft tissue layer just beneath the linen wrappings (Fig:4.18) (Cesarani *et al* 2004:756). The skull model was used for the facial reconstruction and the soft tissue model was used to provide additional information regarding the shape of the nose, ears and lips (Cesarani *et al* 2004:756).

In 2004, the British Museum organized an exhibition entitled "Mummy:the inside story" which featured computer generated images that were displayed in a 3D film presenting a virtual unwrapping and a tour inside the body of the Priest Nesperennub that is still inside the mummy case (Taylor 2004).

In 2008, a radiological study of ancient Egyptian mummies from private and museum collections in Switzerland was published (Jackowski *et al* 2008). The team reported a number

of unusual aspects of mummification techniques in both human and animal mummies such as finding a piece of wood, about 15 cm long, inside the sphenoid sinus of one of the mummified heads; the team suspected that it could have been used during brain removal (Jackowski *et al* 2008:1481). Carbon 14 analysis carried out on the wood specimen extracted from the skull dated the mummy to the Graeco-Roman Period according to the results which indicated a date of around 388 BC to 196 BC (Jackowski *et al* 2008:1481). The team also reported an unusual excerebration technique as the brain of another Roman mummy was extracted through a hole at the temporal bone behind the ear (Fig:4.19) (Jackowski *et al* 2008:1484). The body of the same mummy was eviscerated but had a lack of a side incision which suggests a probable use of an enema (Jackowski *et al* 2008:1484). Another mummy showed an interesting intervention by the embalmer who dislocated one of the ribs and placed it in an upright position to support the rib cage and prevent it from collapsing (Jackowski *et al* 2008:1485).

The last twenty years have seen a large number of CT scanning studies of Egyptian mummies from different museums and collections in Egypt, around Europe and in the USA. There is no doubt that this technique has proved to be a powerful tool in the field of mummy research. On the other hand caution is vital regarding palaeopathological diagnosis from X-ray and CT images as misinterpretations can be easily made. For example, recent research confirmed the presence of atherosclerosis in a number of mummies using CT images by detecting some calcifications or lesions in the walls of blood vessels (Allam *et al* 2009).

However, Charlier and Huynh (2010:1149) disputed the results of this research suggesting that the presence of calcium hydroxyapatite in the vascular vessels of these mummies could have been caused by other conditions such as aging and diabetes. They suggested that microscopic and histological investigations would provide a definite and more precise diagnosis (Charlier & Huynh 2010:1149). The atherosclerosis diagnosis was further defended by Thomas (2010:1150), confirming that the calcification detected in the CT images certainly supports the diagnosed atherosclerosis.

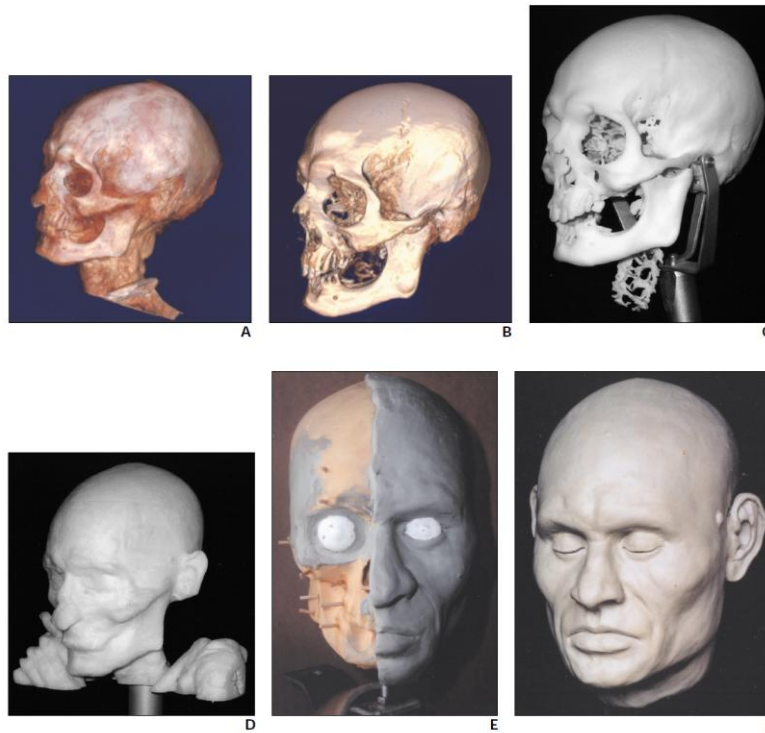


Fig:4.18 The examination of the Mummy of Harwa at The Egyptian Museum, Turin: A- 3D image of the head of Harwa. B- The 3D skull reconstructed image from the CT images. C- Replica of the skull made using laser sintering system. D- Replica of Harwa's head based on the 3D images of the head. E- The model of the skull used to produce a facial reconstruction of Harwa based on the method developed in the University of Manchester. F- The reconstructed face of Harwa.

(from Cesarani *et al* 2004:757)

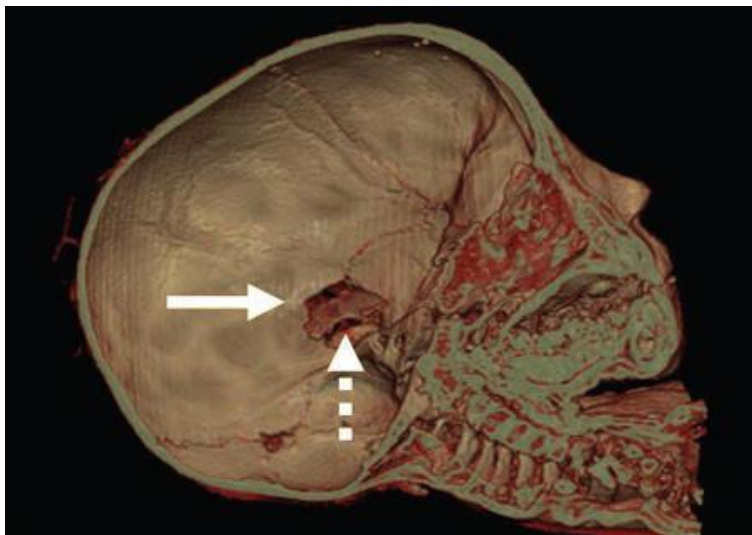


Fig:4.19 The location of the hole made by the embalmer to extract the brain which is usually removed through the nose.

(from Jackowski *et al* 2008:1484)

A study by David *et al* (2010:718-719) associated the findings of atherosclerosis in many mummies including those studied by Allam *et al* (2009), with consumption of daily food offerings which were presented to the gods before being shared amongst the priests. This provided potentially vital information about the diet of this elite group, especially during the Third Intermediate Period (David *et al* 2010:719). Evidence from translations of the wall lists of food offerings in temples points to a high saturated fat intake which supports the atherosclerosis diagnosis by Allam *et al* (David *et al* 2010:719).

I would agree with Chhem (2006:803) who calls for more interdisciplinary collaboration between all the professionals in the palaeopathological field to reach more accurate diagnoses using the radiographic images; however, it would be difficult to support his claim that radiography has not been used sufficiently to diagnose disease in mummified remains (Chhem 2006:803).

4.4 Magnetic Resonance Imaging (MRI):

A study undertaken by Notman and his team reported the unsuccessful attempt of using Magnetic Resonance Imaging (MRI) to examine dry mummies (Notman *et al* 1986:95).

Aufderheide (2003:385) confirmed that statement and explained that the samples have to be rehydrated to enable MRI examination. Another unsuccessful attempt was carried out using new image enhancing techniques in 1996 by Hunt and Hopper to examine the mummified remains of a child at the George Washington Medical Center, Department of Radiology (Hunt & Hopper 1996:16). Recent studies reported that Nuclear Magnetic Resonance Imaging (NMRI) has been used successfully as a non invasive method to examine a finger from an ancient Egyptian adult mummy (Münnemann *et al* 2007:1341) and an intact mummified brain (Karlik *et al* 2007:105).

5. Chapter Four: Subjects and initial observations:

5.1 Subjects:

The subject of this research is a collection of mummies that date back to the Third Intermediate Period and are all part of the British Museum collection of ancient Egyptian artefacts.

5.1.1 The collection of mummies in the British Museum:

Egyptian mummies have always been an important attraction to the visitors of the British Museum since it was opened to the public on 15th January 1759 (Moser 2006:1). The first group of Egyptian artefacts to be on display in the museum came from the collection of Sir Hans Sloane, a collector and medical doctor, who offered them to the government in 1753 (Moser 2006:34). More artefacts were later donated by British collectors and travellers such as Colonel William Lethieullier, who provided the museum in 1756 with the famous 26th Dynasty coffin and mummy of Irtyru which were purchased at Saqqara (coffin EA 6695–mummy probably EA 6694,) ²⁷ (Fig:5.1) (Moser 2006:35). Pitt Lethieullier, William's nephew, also donated a mummy and a coffin to the museum around the same time ²⁸ (Taylor:2011 Per. Com)

²⁷ For further information about the coffins and the mummies presented by W. Lethieullier, P. Lethieullier and King George, see Bierbrier, M. (1988) The Lethieullier Family and the British Museum. In: J. Baines, T.G.H. James, A. Leahy, A.F. Shore (eds.), *Pyramid Studies and other essays presented to I E S Edwards*. London: Egypt Exploration Society: 222-223.

²⁸ T. G. H. James mentioned that the identity of these two mummies is not certain. (http://www.britishmuseum.org/the_museum/departments/ancient_egypt_and_sudan/history_of_the_collection/development_of_the_collection.aspx) (accessed on 8/8/2011).



Fig:5.1 Wooden anthropoid inner-coffin of Irtyru and mummy (coffin EA 6695 & mummy EA6694)

(Mummy from Dawson & Gray 1968:XII and coffin from http://www.britishmuseum.org/research/search_the_collection_database/search_object_image.aspx?objectId=129217&partId=1&orig=%2fresearch%2fsearch_the_collection_database%2fmuseum_no_provenance_search.aspx&numPages=10&idNum=6695¤tPage=1&asset_id=31945)

(Accessed on 29/6/2011)

In 1766, King George III donated to the museum the coffin and the mummy of Itineb²⁹ (coffin EA 6693 and mummy probably EA 6696) (Fig:5.2) which dates to the Late Period³⁰ (Moser 2006:39, Bierbrier 1988:225, Taylor 2010:178). This mummy, which was probably found and brought to England around 1721 (Edwards 1968:v), was mentioned in detail in the 1761 museum guidebook which was prepared by Edmund Powlett (Moser 2006:55).

Two more mummies were added to the collection by Sir William Hamilton in 1772 (Moser 2006:39). By 1759, when the museum was open to the public, four mummies were on display (2 adults, a child and an infant) in the first exhibition room (Moser 2006:46). It is interesting to note here that viewing complete mummies was very uncommon to the British public at that time as it was even considered unsafe to have what was regarded to be a dead body onboard a ship (Moser 2006:252n110). In 1823, the museum had extensive negotiations with Henry Salt, the British Consul-General who conducted excavations in Egypt, in order to provide the museum with Egyptian artefacts (Dawson & Uphill 1995). Mummies were included in Salt's first collection that the museum purchased in 1823 and the letter (S) appears on an old label on one of the coffins (EA 6666, Fig:5.3). In 1834, six more mummies were obtained by the museum from the collection of Joseph Sams. The mummies were described by Sams as "*not to be equalled in any other collection*" during the long negotiations between him and the museum trustees in order to encourage them to accept his offer and purchase his collection. In 1835, another mummy (EA 6692) was presented to the museum from the collection of Alexander Turnbull Christie, a British medical doctor who visited Egypt in 1832 to study cholera. While in Alexandria, Christie bought the mummy from Giovanni d'Athanasia (Dawson & Uphill 1995). In 1839, the British Museum purchased the second collection of Giovanni Anastasi which included the cartonnage case and mummy of Padiamunet (EA 6682, Fig:5.45) (Taylor 2009a:561,573).

²⁹ E.W. Montagu brought this mummy from Egypt in 1721 and presented it to King George III who later donated it to the museum (Dawson & Gray 1968:23, Edwards 1968:v).

³⁰ The face of the coffin is painted bright green which is a feature that only appeared after 650 BC. The 26th Dynasty would be the earliest possible date for the coffin (Taylor 2001a:240). For further information about the coffin of Itineb, see Taylor 2001a:240, Taylor 2010:178-179.



Fig:5.2 Anthropoid coffin and mummy of Itineb (coffin EA 6693 & mummy EA 6696).

(Coffin from Taylor 2001a:240, mummy from Dawson and Gray 1969:Pl X)



Fig:5.3 Coffin of Pasherihoraawesheb containing the mummy of a female (EA 6666), part of Salt's first collection.

(From

http://www.britishmuseum.org/research/search_the_collection_database/search_object_image.aspx?objectId=117340&partId=1&orig=%2fresearch%2fsearch_the_collection_database%2fmuseum_no__provenance_search.aspx&numPages=10&idNum=6666¤tPage=1&asset_id=425645

(accessed on 29/6/2011)

An early illustration shows rows of showcases full of mummies in the New Egyptian room which was opened to the public in 1837 (Moser 2006:158). During this era, most of the mummies acquired by the museum were on display which impressed the visitors; one mentioned in his account:

“What a number of mummies and ornamented mummy cases are here! And yet this is London, and not Egypt.”

(Moser 2006:168).

The museum's attitude towards acquiring Egyptian artefacts which includes mummies had developed from donations, to accepting, after some negotiations, offers to purchase collections, specific purchasing from auctions, or sending their own agents to acquire them direct from Egypt (Moser 2006:219). There was a large market for mummies as they have always been considered by the antiquities dealers as profitable objects and easy to sell (Moser 2006:219).

In 1882, the Egypt Exploration Fund was formed and provided the museum with a large number of objects from its excavations in Egypt (Moser 2006:8). Towards the end of the 19th century, major changes took place in Egypt as a result of strong national feelings. This resulted in the formation of the Egyptian Antiquities Service in 1856 and the antiquities museum was established. Certain rules and export licences were required for ancient artefacts to leave Egypt (Moser 2006:240). This must have had its affect on the number of objects available in the antiquities market which could be acquired by the museum. Budge acquired many mummies for the British Museum during his time as Keeper of the Egyptian Department. These mummies covered all historical periods from Predynastic to Roman³¹ (Fig:5.4).

In 1893, the Duke of Sutherland donated a mummy of an elderly female (EA 24957) and a mummy case to the British Museum. The mummy was unwrapped by Sir Richard Owen in 1873 before it was given to the museum (Dawson 1927:161). For some time, it was believed that this was the same mummy that Birch unwrapped in 1875 at Stafford House which was donated to the Royal College to Surgeons, although it was of an elderly short man (Dawson 1927:156). This confusion, probably caused by a mistake made by Budge, was solved by Dawson who examined both mummies and published his findings (Dawson 1927:156).

³¹ In 1886, Budge examined the mummy and coffin of the Priest Nesames as soon as they arrived in London and were later presented to the museum by Capt Collingwood Ingram (Budge 1886:106)

Later, British Egyptologists were able to conduct professional, scientific and well documented excavations in Egypt and take a share of the finds under the new Egyptian legislations.

A selected group of the Third Intermediate Period mummies from the collection of the British Museum was examined during this study. The group includes males and females from different social backgrounds. The mummies were transported from the British Museum to Manchester Royal Infirmary for examination; I have also visually examined and photographed them at the British Museum.



Fig:5.4 The First Egyptian Mummy Room at the British Museum as it appeared in 1857.

(from Moser 2006:199)

5.1.2 The Technique used to manufacture a Cartonnage Mummy Case:

As most of the selected mummies for this study were each encased in a full cartonnage case, it has been essential to explore the techniques used to produce these cases. The Ancient Egyptians did not leave any documents or manuals describing how these cases were produced and few studies were carried out to examine the techniques used to manufacture full mummy cartonnage cases. In 1834, Pettigrew (2007:116-117) described Dr. Lee's mummy as an example of a cartonnage case. He concluded that the case must have been manufactured by placing the soft gummed layers of linen directly on the body of the deceased (Pettigrew 2007:116). He also noted that the facial features did not represent the real face of the deceased but were stylised for either a male or a female (Pettigrew 2007:116).

A brief description was later given by Samuel Birch (1874:199) who stated, following the examination of a number of mummies and more or less repeating what Pettigrew mentioned previously, that the pasteboard cases were made of linen and lime and that they were constructed or moulded directly over the wrapped mummy. Another case examined earlier by Birch, in 1850, was more than 0.5 cm thick and was made up of around twenty layers of linen (Birch 1850:276). Birch described the case as:

“consisting of several folds of linen glued together by some viscous substance, and then covered with a remarkably smooth and thin layer of stucco, on which had been neatly painted certain religious subjects.”

Birch (1850:274) also noticed that the mummy, which was of a female, was shorter than the case which does not support his subsequent conclusion of the production technique of direct moulding. Birch (1850:275) reported the application of a thick coating of plaster inside the case to reduce the difference in height between the mummy and its case. Black resin was poured over the cartonnage case covering most of its painted surface except the back and the sides where few figures and lines of inscription were visible (Birch 1850:274). The mummy was removed for examination by cutting the cartonnage case vertically in two halves, right and left sides, to preserve the visible inscriptions and scenes on both sides of the cartonnage (Birch 1850:275).

No details about the lacing at the back of this cartonnage case were mentioned by Birch but during another unrolling of a mummy at Stafford House which took place in 1875, Birch reported that the case was “*laced up like stays behind*” (Birch 1877:122). Although the lacing cord of this mummy had been replaced by a modern equivalent, Birch (1877:122) was certain that the mummy was intact.

During the excavations led by Quibell (1898:9) at the Ramesseum, over two hundred tombs belonging to priestly Theban families who lived during the Third Intermediate Period were discovered. Cartonnage cases dating back to the 22nd Dynasty were found and briefly examined by Quibell (1898:10) who removed the mummy of Nekht ef Mut³² (Fig:5.5) from the case and described the technique used to produce this case as:

“ .. the body after mummification was enclosed in a case of linen cartonnage, made on a model mummy, and this was laced together down the back. A piece of wood was laced on for the foot piece, and then a layer of fine white plaster of about one-sixth of an inch was laid over the whole; this was moulded in relief for the figures, and on it all the decoration was painted.” (Quibell 1898:10)

³² The cartonnage case of Nekhtefmut is now in the collection of the Fitzwilliam Museum, Cambridge, museum no:E 64.1896.



Fig:5.5 Cartonnage case of Nekht ef Mut, 22nd Dynasty, found in the Ramesseum by Quibell in 1896, now at the Fitzwilliam Museum, Cambridge (E64.1896).

([http://www.fitzmuseum.cam.ac.uk/ functions/imagewindow.php?http://www-img.fitzmuseum.cam.ac.uk/img/ant/ant20/E.64.1896\(1\).jpg](http://www.fitzmuseum.cam.ac.uk/functions/imagewindow.php?http://www-img.fitzmuseum.cam.ac.uk/img/ant/ant20/E.64.1896(1).jpg))

© Fitzwilliam Museum, Cambridge, UK

(Accessed on 29/6/2011)

Adams (1966:56) mentioned a more recent report which also suggested that direct moulding on the mummy was the technique used to produce cartonnage cases. In 1966, during a radiographic investigation of the mummy of Shepenmut³³ (EXE .7) (Fig:5.6) at the Royal Albert Memorial Museum and Art Gallery, Exeter, Adams (1966:55) removed the mummy from the cartonnage case in order to obtain clearer radiographic images. As the mummy was part of the museum's collection and the removal process would potentially compromise prospects of future display, Adams carefully sawed the cartonnage horizontally starting from the feet towards the shoulders, the head and back to the feet, again resulting in separated upper and lower halves. The same cutting technique was used by Newberry in 1901 to examine the mummy of Pa-di-mut which was discovered in the Valley of the Kings (Farrell *et al* 2006:2). Thomas Nelson Page, the American ambassador in Egypt, wrote in his diary that the process of separating the cartonnage into two halves longitudinally took around 15 minutes (Farrell *et al* 2006:3).

Radiographs taken previous to the removal of the mummy of Shepenmut were used as a guide during the cutting of the cartonnage by Adams. The removal of the mummy was accomplished in addition to providing access to the inside walls of the cartonnage which allowed the study of the manufacturing techniques (Adams 1966:55-56). Evidence of a space between the head of the mummy and the internal surface of the cartonnage supported the conclusion that direct moulding of the case on the wrapped mummy was not the manufacturing method as suggested by Birch. Another reason for rejecting the direct moulding technique is the presence of the slit and lacing at the back of the cartonnage which indicate that the case had to be opened for the mummy to be placed inside (Adams 1966:57).

³³ More information about this cartonnage case can be found at:
http://www.bris.ac.uk/archanth/staff/dodson/ecpuk_files/exeter



Fig:5.6 Cartonnage case of Shepenmut
 (B & W) (Adams 1966:56),
 (from http://www.bris.ac.uk/archanth/staff/dodson/ecpuk_files/exeter
 (Accessed on 3/7/2011).
 © 2011 Royal Albert Memorial Museum & Art Gallery, Exeter

Adams provided a full reconstruction of the steps of the manufacturing techniques:

- A core was made from a mixture of mud and straw built around a light weight core of straw. The outer surface of the core was made in the shape of the cartonnage case and was slightly bigger than the mummy.
- A layer of coarse plaster was then applied to the wet surface of the mud and straw core. This layer was not applied on an oval area at the back of the core; this is where Adams (1966:62) found a layer of mud and straw stuck directly to the linen layers.
- Strips of linen soaked with an adhesive, probably gum, were then applied to the dry and hardened coarse plaster. Adams (1966:63) mentioned that around seven layers of material were applied while Birch (1850:276) suggested twenty layers as mentioned above.
- A straight slit was then made at the back, almost along the whole length of the cartonnage, and the core was then taken away (Adams 1966:63)³⁴.
- Fine plaster³⁵ was then applied to the surface of the linen. A thicker layer of plaster was observed on the front and the sides while the plaster on the back was very thin³⁶.
- The lacing holes were then prepared carefully from outside and along the edge of the slit. They are positioned at the same distance from each other. Evidence of drips of plaster on the interior of the case which correspond with the holes support the conclusion that the case was empty during the application of a fine layer of plaster after the lacing holes were punched³⁷.
- The wrapped mummy was then placed inside the cartonnage using the long slit at the back before it was closed using a long lace, starting from the head and ending at the feet³⁸.
- A strip of resin soaked linen was then added to hide the laced area and then covered with a layer of plaster.

³⁴ The core would be removed in pieces (Taylor 1992a:166) but in many cases remains of the core were still attached to the inside of the cartonnage especially within the smaller details of the face and wig as reported by Adams (1966:61) and Farrell *et al* (2006:6). Taylor (1992a:166-167) also referred to the same observation in a similar cartonnage at Bolton Museum (38.95.2).

³⁵ Lucas suggested that the plaster material used to cover the surface of the cartonnage cases is gesso (Adams 1966:57).

³⁶ Similar observation was made during investigating of the cartonnage case of Padimut by Newberry in 1901.

³⁷ Further observations during the examination of the mummy of Padimut support the same conclusion as drips of white plaster were found inside the case, over the remains of mud and straw and over the wooden foot board which indicate that the case was placed to stand vertically after the core was removed (Farrell *et al* 2006:7).

³⁸ Linen wads placed inside the cartonnage cases as cushions between the wrapped head of the mummy and cartonnage case were reported in some cases, such as the mummy of Padimut (Farrell *et al* 2006:6) and of Shepenmut (Adams 1966) .

- A wooden foot board, added to protect the feet of the mummy, was secured in place using wooden pegs.
- The final step in the manufacturing of the cartonnage case was applying the decoration on the plaster surface.

In 2004, a study was conducted at the British Museum, Department of Ancient Egypt and Sudan, to produce a number of replicas, half and two thirds of the size of a full cartonnage case, following the same techniques used by the Ancient Egyptians and described by Adams. During that study a boroscope was used to examine the inside of the cartonnage cases for any evidence of manufacturing techniques and to take samples without disturbing the wrapped mummies or the cases (Taylor & Davey 2005:26). The study, although successful, was not fully published (Taylor 2011:Per. Com.). However, a full size replica was produced during a similar study that was conducted and published in Germany by Krekeler (Fig 5.7 & 5.8) (2007:13- 32).

In 2006, the cartonnage case of Padimut, a priest of Amun and a metalsmith, who lived during the 22nd Dynasty, was examined (Farrell *et al* 2006:4). A full study of its manufacturing techniques and materials was conducted using different methods including radiography and microscopy so that treatment methods and techniques could be decided (Farrell *et al* 2006:5). A small size model of a cartonnage case was also prepared during this study by the conservation team to demonstrate the fabrication techniques previously described by Adams (Farrell *et al* 2006:6). The meticulous study and observation of Padimut's cartonnage especially along the sawn edges, revealed that double layers of linen were prepared and glued together before they were applied to the former or the straw and clay model (Farrell *et al* 2006:6). It was also noted that the double linen layers were deliberately applied in different weave orientations which strengthens the case (Farrell *et al* 2006:6).

The study of cartonnage cases has highlighted some differences in the manufacturing techniques, such as the number and location of the back slits. For example, the case of Padimut has a long vertical slit at the back of the case in addition to two horizontal slits, one near the head and the other one near the feet. Both horizontal slits intersect with the long vertical slit creating two easily folded flaps which facilitate both the extraction of the mud and straw core and the insertion of the wrapped mummy (Farrell *et al* 2006:7). This case is

different from the cartonnage of Shepenmut which only has one long vertical slit (Adams 1966:64).

Another difference in the manufacturing technique is the method used to attach the foot board to the cartonnage case. In the case of Padimut, the wooden board was stitched into the base of the cartonnage and secured in place before the mummy was placed inside (Farrell *et al* 2006:7) while the foot board of the Shepenmut cartonnage was positioned after the body had already been placed inside the case, and then the board was attached to the base using small wooden pegs that were flattened and smoothed (Adams 1966:66). Taylor (1992a:167) mentioned the technique observed in the mummy of Shepenmut as the most common and widely used method of supporting the foot board. This would allow the fastening and tightening of the laces at the bottom of the case: the ends of the lace could also be hidden inside the case before the final step of attaching the foot board.

Almost all the cartonnage cases studied during the last century came from Thebes as Taylor (1992a:166) mentioned which makes our knowledge about the manufacturing of cartonnage case in the north very sketchy. Most of the researchers assume that same methods used in the south were applied in the Delta.

The details and proportions of the face in the cartonnage case are remarkably accurate and precise which may point to the use of a hard mould made of wood or stone and attached to the core before the gummed linen was applied (Taylor 1992a:166). This mould would be removed with the mud and straw core from the slit at the back and would be reused for making another cartonnage (Taylor 1992a:166).

Taylor (1992a:166) also suggested another method: the prefabrication of the main elements of the face, i.e. the eyes, the mouth and the nose, from layers of linen soaked in gum which were then attached to the face area during the application of plaster to the surface of the cartonnage. Evidence of this technique was reported during the examination of cartonnage masks from the Second Intermediate Period (Taylor 1992a:166).



Fig:5.7 Illustration of the steps used to manufacture a replica of a one piece cartonnage case. From left to right: The wooden support, the straw core, the mud and straw former and the first phase of the cartonnage with a white coarse plaster layer. (the mouth was modelled separately and was later attached to the cartonnage. (Krekeler 2007:18).



Fig:5.8 The final stage of the successful manufacturing of a replica of a one piece full cartonnage. (Krekeler 2007:18).

5.1.3 The Selection Process:

A survey of all the mummies and human remains that belong to the Third Intermediate Period in the collection of the British Museum, Department of Ancient Egypt and Sudan, was undertaken using Merlin, the database of the museum. Discussions with museum curators took place as the database provided some contradictory information. A list of 19 mummies was prepared³⁹ (EA 6659, EA 6660, EA 6662, EA 6676, EA 6681, EA 6682, EA 6692, EA 6697, EA 15654, EA 20744, EA 22812, EA 22939, EA 25258, EA 29577, EA 30720, EA 32052, EA 41603, EA 48971, EA 74303)

The selected mummies were chosen according to their state of preservation and condition. The Department of Conservation and Scientific Research at the museum was consulted and only suitable mummies were allowed to travel for radiographic examination. Due to the application of resin in ancient times, in one example (EA 6662) (Fig:5.9) it was impossible to separate the mummy from the coffin. Measurements were taken to examine the possibility of placing the whole coffin in the CT scanner but it proved to be impossible as the coffin was much larger than the available space⁴⁰.

The conservator also advised against transporting another mummy (EA 6660) (Fig:5.10 & 5.11), as a layer of resin that was applied to the surface of its wrappings was loose and travelling would have caused damage to this layer.

Availability was also a major factor in the selection process as some of the mummies were travelling as part of external exhibitions during the period scheduled for the radiological examination. Other factors, such as being on display in the Egyptian galleries and transportation expenses, had to be considered during the selection process.

³⁹ See appendix Five for the full list.

⁴⁰ Birch (1850:274) briefly described the cartonnage case as being glued to the coffin by the bitumen that was generously applied to cover the case. He also added that the case was painted then gilded but the painting can still be seen under the gold layer. The museum number that was given to this mummy by Birch is 6682 which does not correspond with the name (Khonsaufankh) or the description he mentioned. The correct number is EA6662.



Fig:5.9 (EA 6662) Mummy of Djedkhonseufankh, 22nd Dynasty. Molten resin was applied to the cartonnage case after it was placed inside the coffin which caused the cartonnage to permanently stick to the base of the coffin. As the width of the coffin was more than the width of the CT scanner, it was impossible to examine the mummy even within the coffin.



Fig:5.10 (EA 6660), A layer of molten resin was applied in antiquity to the surface of the wrappings which became loose in many areas. For this reason, this mummy could not be transported to Manchester for examination.






Fig:5.11 (EA 6660) Detail of the head area shows the poor state of preservation and the fragments of the layer of resin on the linen wrapping.

5.2 Subjects and Initial observations:

Access to the museum's storeroom and database was granted and facilitated by the museum's curators and staff. A list of the Third Intermediate Period Mummies including the mummies on display in the Egyptian Gallery and the mummies in the storeroom has been produced. The mummies from the selected group were photographed and detailed digital images of the mummy cases with special attention to the inscriptions on the cases and wrappings were obtained.

5.2.1 EA 6659: Wrapped mummy inside the outer/intermediary wooden coffin of *Hor*

According to Dawson and Gray (1968:21), the mummy was inside a wooden coffin which is part of the ensemble on display in the gallery⁴¹. The British Museum online database record mentions that the mummy was part of the Salt Collection before it was purchased by the museum in 1823 (Fig:5.14). The mummy and the coffins were on display in the First Egyptian room in 1898 in Case L (Budge 1898:29). However, in 1857, it was on display in case 68 in the same room according to Synopsis of the contents of the British Museum (Fig:5.12) (1856:241) and continued to be in the same case as recorded by Birch (1879:58).

The name inscribed on the coffin is *Hor* (Fig:5.17) who was an incense bearer in the temple of Khonsu at Thebes (Budge 1898:29). Hor was the son of Tjaai (father)  and Tetjhy  (mother). His grandfather was Wennefer  whose title was mentioned on the coffin as *sAb* (Dawson & Gray 1968:21).

5.2.1.1 Coffin's decoration:

The coffin was recorded to be made of Sycamore wood (Birch 1879:58). The decoration of the coffin is remarkable due to the unusual grey background colour chosen by the ancient

⁴¹ Dawson and Gray (1968:21) mentioned that the mummy was inside a cartonnage case. The same information, which is incorrect, was repeated in the museum's online database. The earliest reference to the mummy and the coffin of Hor appears as a brief description in a *Synopsis of the contents of the British Museum* (1838:218). There is no mention of a cartonnage with the mummy and coffin. A detailed description of the ensemble was mentioned in a later edition (1840:288-289) as 'The mummy is placed between the lid and chest; it is neatly bandaged in blue striped linen, with transverse bandages of yellow, pink and reddish brown.' This description corresponds with the mummy (EA 6659), except that the coloured bandages have faded.

artist (Taylor 2001b:172). While Dawson and Gray (1968:21) suggested a Late Dynastic dating for the coffin, it was included as an example of the 22nd Dynasty coffins by Taylor (2001b:172) who also suggested that the grey background colour could represent silver which was used during this period for royal coffins (see chapter two). The decoration on the wooden coffin lid resembles that on contemporary cartonnage cases and belongs to the style “*design 2*” according to Taylor’s classification (2003:107). This is the most common design of that type which included the ram-headed Horus⁴²(Fig:5.15, 5.16), representing the sun god at dawn, on the chest and the Abydos fetish on the lower area (Taylor 2003:106). This composition refers to the rebirth of the sun following its journey through the kingdom of Osiris during the night (Taylor 2010:70-71). Based on the design type and the style of a representation of the unguent cone on the head, this coffin is dated to the first half of the 22nd Dynasty (Taylor 2003:106, Taylor 2011:Per. Com).

The representation of Maat on the neck (Fig:5.13), to convey that the deceased has passed the judgment, is a common feature of the coffins of this period (Taylor 2003:105).

5.2.1.2 Radiological findings:

Dawson and Gray (1968:21) noted that artificial eyes had been placed by the embalmers over Hor’s eyes. They also reported the absence of many of Hor’s teeth, a scarab over the abdominal area and evidence of circumcision. The X-ray images showed that there is a figure located between the legs of the deceased, placed there by the embalmers (Fig:5.19). In 1965, shortly after the X-rays revealed this figure, it was removed from the mummy through an incision through layers of wrapping at the back of the mummy (Dawson & Gray 1968:21, Taylor 2011:Per. com) (Fig:5.20). The X-ray images were used to guide the operation in order to minimise disturbance of the mummy and its wrappings. The figure (EA 66849) (Fig:5.21) which is made of unfired clay appears to have evidence of corn kernels on its back (Taylor 2011:Per. com). In February 1998, a Xeroradiographic examination of the clay figure took place in order to confirm or dismiss the identification of the object as a corn mummy (Taylor 2011:Per. com, The British Museum Online Database). The images showed an unidentified lower density cylindrical object located near the centre (Fig:5.22) (Taylor 2011:Per. com).

⁴² The inscription accompanying the ram headed Horus refers to him as “Lord of Behdet”.



Fig:5.12 The First Egyptian Room. (arrow) Possibly Case L or Case 68 where the mummy and coffin of Hor (EA 6659) were on display according to Budge (1898:30). (from Moser 2006:199)

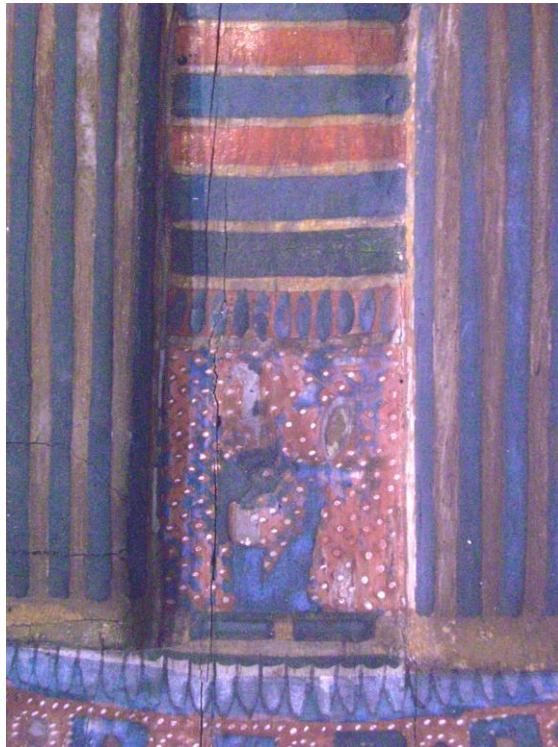


Fig:5.13 coffin lid of Hor (EA6659). Maat is represented on the neck area between the lappets of the wig in order to convey that the deceased has passed the judgment (Taylor 2003:105).



Fig:5.14 Coffin lid of Hor (EA 6659). The name of Salt and the year 1821 are inscribed at the bottom of the feet area of the lid.



Fig:5.15 (EA 6659) Detail of the solar form of Horus represented as a ram-headed falcon with a solar disc on his head representing the sun god at dawn.



Fig :5.16 (EA 6659) “Lord of Behdet” inscribed next to the ram- headed winged Horus on the chest of the coffin lid.



Fig 5.17 (EA 6659):The lower part of the coffin lid of Hor (arrow points to the name of the deceased).



Fig:5.18 (EA 6659) Lower part of the coffin with Hor's titles, the name of his father (Tjaai) and grandfather (Wennefer).

(from:http://www.britishmuseum.org/research/search_the_collection_database/search_object_image.aspx?objectId=117337&partId=1&orig=%2fresearch%2fsearch_the_collection_database%2fmuseum_no_provenance_search.aspx&numPages=10&idNum=6659¤tPage=1&asset_id=405415)

(Accessed on 29/6/2011)

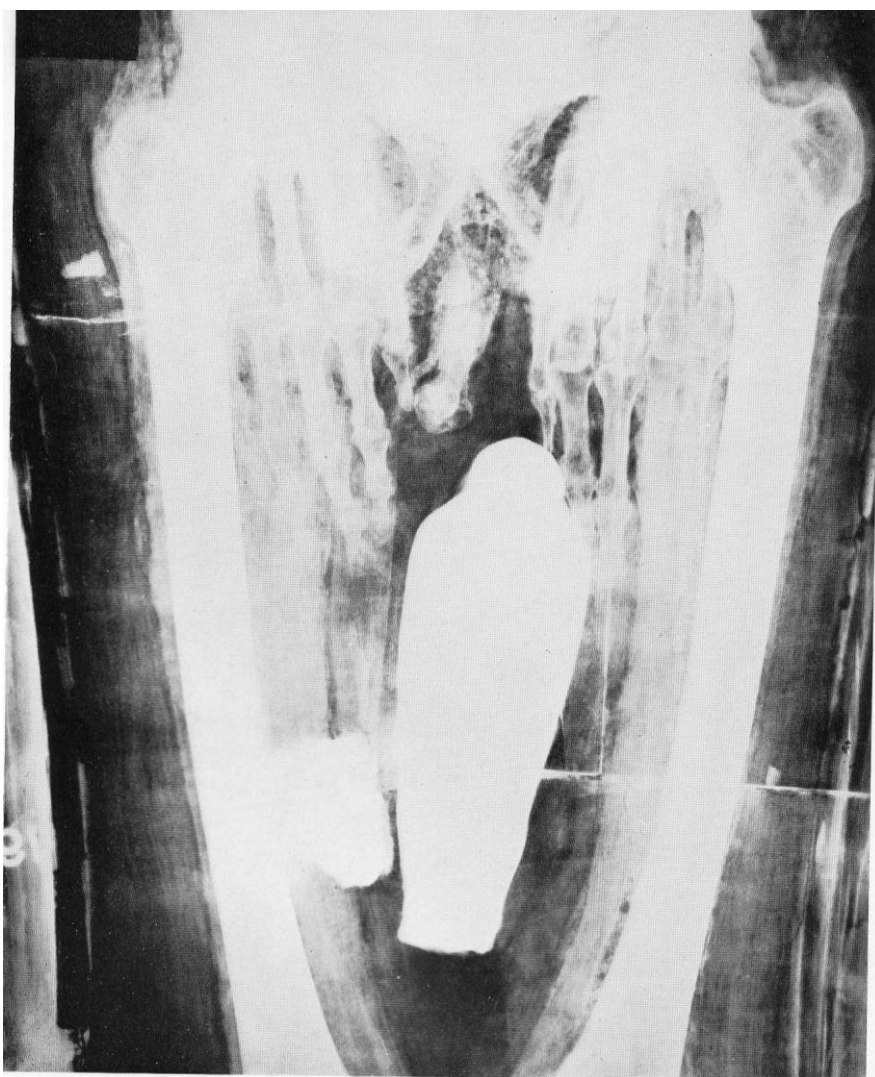


Fig:5.19 (EA 6659) X-ray image of the mummy of Hor showing a mummiform figure between the upper legs. (from Dawson & Gray 1968:Pl XXX -c).



Fig:5.20 (EA 6659) The mummy of Hor during the extracting of the figure detected during the radiological examination of the mummy⁴³.

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⁴³ I would like to thank Dr. John Taylor for providing these photos.



Fig:5.21 (EA 66849) The unfired clay figure found within the wrapping of the mummy of Hor (EA 6659). (from Dawson & Gray 1968:Pl XXI).

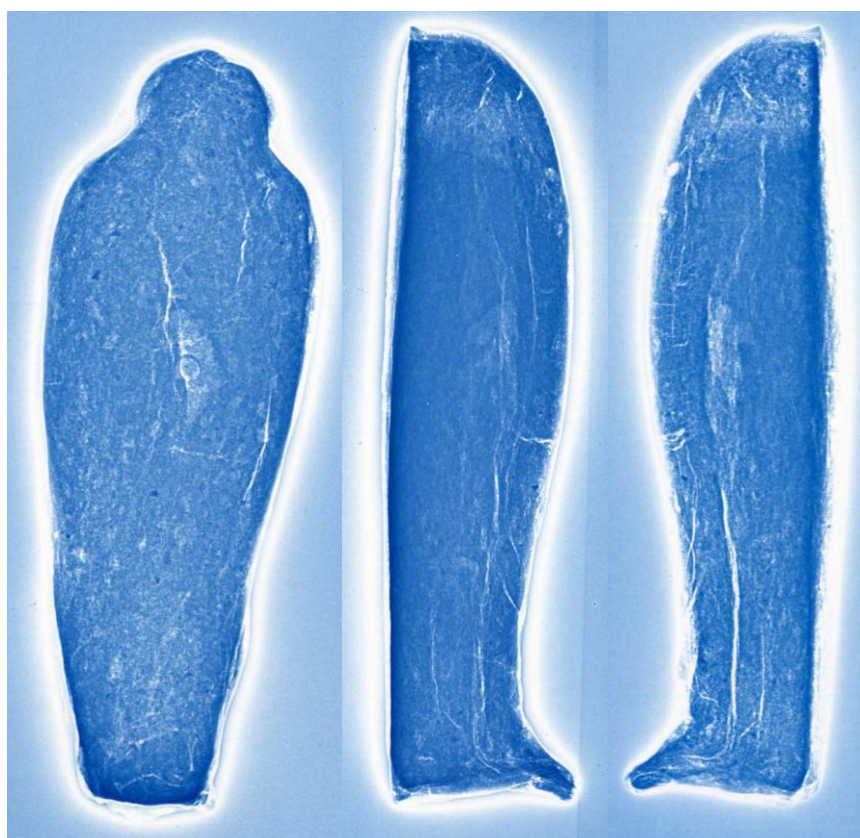





Fig:5.22 (EA 66849) Xeroradiographs of unfired clay figure found inside the mummy of Hor (EA 6659). The images show a small unidentified cylindrical low density object in the centre of the figure⁴⁴.

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⁴⁴ I would like to thank Dr. John Taylor for providing these images.

5.2.2 EA 6681: Painted mummy-case of *Pef-tauemawy-khonsw* (Fig:5.23. and Fig:5.24)

The deceased was also known as *Anx-wnn-nfr*  (Dawson & Gray 1968:11) as inscribed on the mummy case. The name of his father was mentioned in the text as *Dd-Hr-
iwf-anx*  and his mother was *Tnt-wAH-mut*  (Fig:5.25) (Dawson & Gray 1968:11). The text also mentioned that Ankhwennefer and his father were both priests (servants) in the temple (Dawson & Gray 1968:11). The cartonnage case dates back to the 25th Dynasty⁴⁵ and was originally found in Thebes (Budge 1898:31). There is no acquisition information available regarding this mummy. According to Budge (1898:31), the mummy was on display in case M together with another two mummies in the First Egyptian Mummy Room.

This case contains the mummy of a young adult male which was examined by Gray and Dawson using a portable X-ray apparatus and the results were published in 1968. The original X-ray images are stored in the archive store of the Department of Ancient Egypt and Sudan, The British Museum⁴⁶.

5.2.2.1 The decoration of the cartonnage:

Payeftjauemawykhnw is represented on his case wearing an elaborate striped blue and yellow wig. Remains on the wig suggest that the ears were represented but are now missing. A mark under the chin also suggests that a false beard was once attached to the face. A black scarab is depicted on the top of the head. A brightly coloured wide collar is depicted on the chest. Below the collar, there is a depiction on the chest of the solar ram-headed winged falcon representing Horus. The Four Sons of Horus are represented in two pairs on each side of the ram-headed falcon. Below the ram-headed falcon, there is another representation of a falcon stretching its wings over the abdomen of the deceased and standing on the fetish of

⁴⁵ The record of this mummy in the British Museum online database mentions that it dates back to the 21st Dynasty.

(http://www.britishmuseum.org/research/search_the_collection_database/search_object_details.aspx?objectId=117334&partid=1&IdNum=6681&orig=%2fresearch%2fsearch_the_collection_database%2fmuseum_no__provenance_search.aspx), while Taylor (2011:Per. Com) dates it to the late 22nd Dynasty or early 25th Dynasty.

⁴⁶ Access to the archive store was facilitated by Dr. John Taylor, Assistant Keeper, The Department of Ancient Egypt and Sudan, The British Museum.

Abydos⁴⁷; that is, depicted in the centre of the case and dividing it into two symmetrical sides, and extending from the abdomen towards the feet. A number of deities are represented on the case on both sides of the fetish of Abydos such as winged falcons, Anubis, Selkis and Neith. A symmetrical scene over the foot area of the case represents Wepwawet as a jackal with burning incense.

The signs *Ankh*, *Neb* and *Was* (Fig:5.26) are repeated on the feet area of the cartonnage; this can be seen in a number of cases such as the cartonnage of Penu⁴⁸ (Fig:5.27). There are similarities between these two cartonnages that could suggest that both were made in the same workshop.

A foot board used to be attached to the foot area but has been separated from the cartonnage case. A scene represents the Apis bull which, characterised by distinctive markings and standing on the hieroglyphic sign of the foreign land, is depicted on the wooden board. The bull is wearing a large collar with a counterpoise⁴⁹. The name of the deity, Ptah, is also inscribed above the bull, demonstrating the association of the Apis bull with the Temple of Ptah at Memphis (Taylor 2001a:248).

5.2.2.2 Radiological findings:

Only one X-ray image was included in the publication showing packages in the chest area and disarticulated vertebrae. The X-rays indicate that the mummy was disturbed and restored in antiquity (Dawson & Gray 1968:11). Evidence on the mummy case supports this conclusion as the ancient restoration is visible (Fig:5.26). This could possibly indicate that the wrapped mummy does not belong to the mummy case and that the case was used as a substitute for the original case which may have been destroyed and plundered in antiquity. However, the gender of the mummy corresponds to the gender inscribed on the mummy case which may suggest that the mummy belongs to the mummy case if supported by other evidence. The names and titles have not changed on the case which would have been easily observed if they were obscured by the name of a second occupier. Furthermore, the name of the new occupier could have been added which is not the case. Dawson and Gray (1968:11)

⁴⁷ The fetish of Abydos represents Osiris and his netherworld kingdom (Taylor 2010:90).

⁴⁸ For more information on the cartonnage case and mummy of Penu (MFA 72.4839c) which is part of the collection of the Museum of Fine Arts, Boston, see Taylor 1992b:168-169.

⁴⁹ For further information on the Apis bull, see Taylor 2001a:247

suggest that the cartonnage case could have been a replacement for the original case that may have been damaged by tomb robbers while plundering the mummy.

The X-ray radiographs showed absence of all cervical vertebrae in addition to some missing teeth, most probably to have been due to looting (Dawson & Gray 1968:11). They also show two large high density packages (Fig:5.28) in the thoracic cavity which may be made of a hardened mixture of sand, mud and resin in an attempt to restore the shape of the damaged ribs (Dawson & Gray 1968:11-12). Subcutaneous packages were placed under the skin of both lower legs (Dawson & Gray 1968:12).



Fig:5.23 (EA 6681) Cartonnage case of Payeftjauemawykhons. The decoration follows the typical southern style especially the large ram-headed winged solar falcon (representing the son god at dawn) that covers the chest and the fetish of Abydos according to Taylor (2009:378).

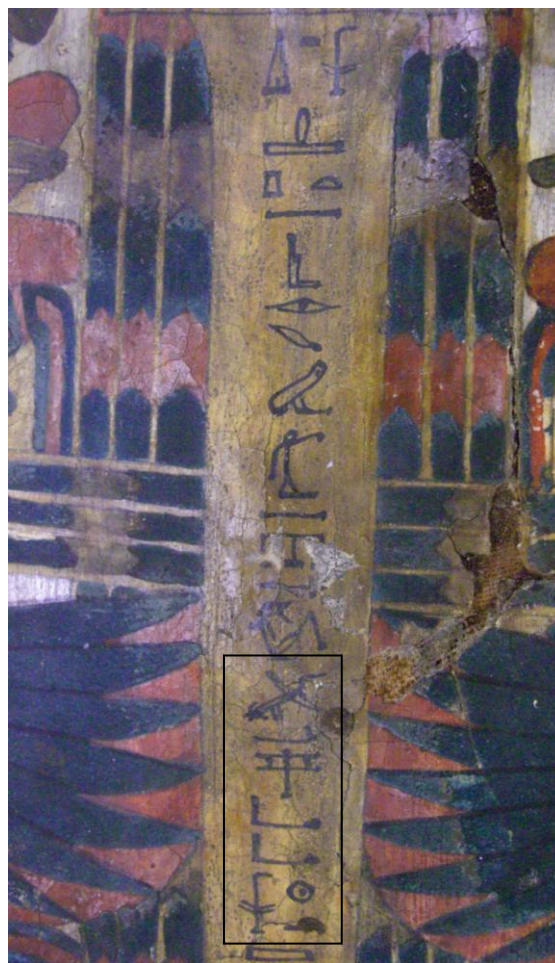


Fig:5.24 (EA 6681) Detail of the horizontal line of inscription on the case showing the name of the deceased (pA f TAw (im)awi xns) Payeftjauemawykhons.



Fig:5.25 (EA 6681) Detail of the horizontal line of inscription at the lower part of the case. The names of the father and mother of the deceased appear as Dd Hr iwf Anx and Tnt wAH mwt respectively. (sA sDm aS Dd Hr iwf Anx mAa Xrw mwt.f Tnt wAH mwt)



Fig:5.26 (EA 6681) Detail of the repeated design of *Ankh- neb- was* on the feet area of the cartonnage following design 2 B according to Taylor (2003:105).The photo also show evidence of ancient restoration



Fig:5.27 The cartonnage case of Penu, (MFA 72.4839c) The same detail of the repeated ankh-neb-was sign at the feet area of the cartonnage (similar to EA 6681). Other similarities between the two cartonnages may suggest being made in the same workshop. (Type 2B according to Taylor (2003:Pl 48).

(full cartonnage from Taylor 2003:Pl 48)

Detail (from Taylor 1992b:168).

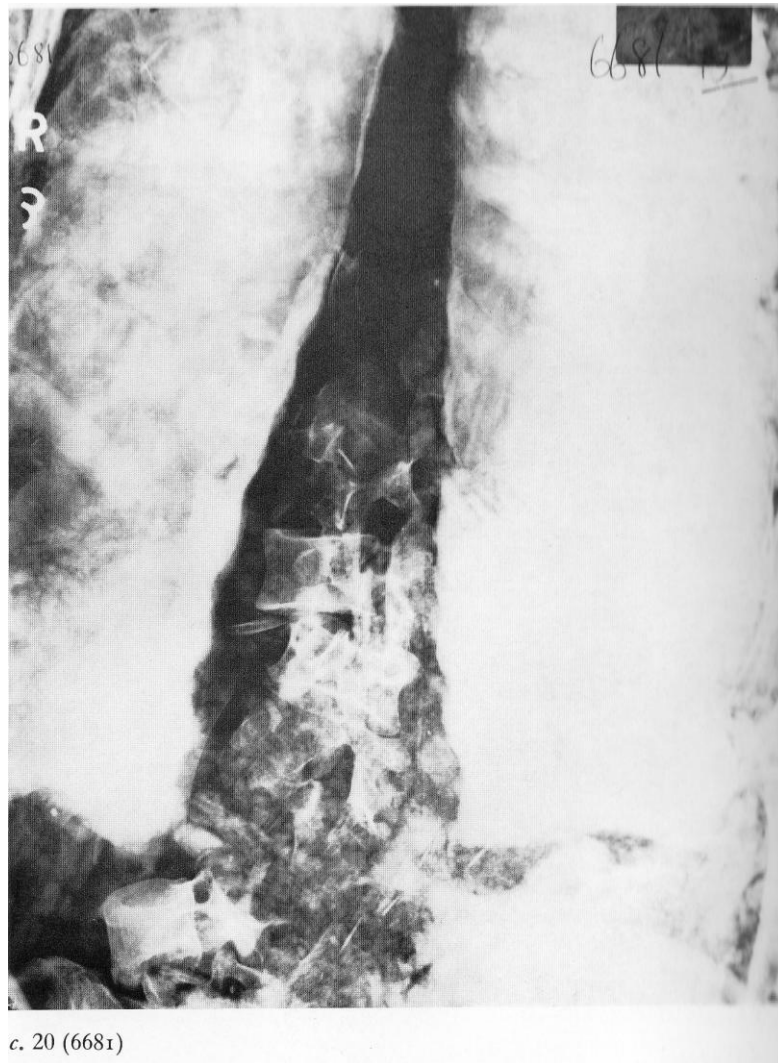


Fig:5.28 (EA 6681) X-ray radiograph of the chest showing two high density large packages in the thoracic cavity. Dawson and Gray (1968:11-12) suggested that they were made of mud, sand and resin in order to secure and hold together all the pieces of broken ribs and vertebrae.

(from Dawson & Gray 1968:PL XXVI- c)

5.2.3 EA 6682: Painted mummy case of Padiamunet (var. Padiamun).

This mummy case (EA 6682) (Fig:5.44) and its coffin (EA 6683) were purchased from the collector, Giovanni Anastasi in 1839⁵⁰ (Taylor 2009a:562). The mummy was mentioned by Birch (1879:59) to be on display in case 65 in the First Egyptian Room. Later, the mummy was radiologically examined by Dawson and Gray (1968:14).

According to the style of decoration, the cartonnage case dated to the 25th Dynasty (Taylor 2001b:174, 2010:59). Taylor (2001b:174) explained that in this particular style, the proportions of the human figures which resemble those in art of the Kushite period, the name of Osiris appears with the divine pennant and a black line frames each letter of the hieroglyphic inscription which is painted blue over the white background of the cartonnage (Fig:5.29). A layer of varnish was applied only over the painted scenes which results in a contrast between the text on the white background and the varnished painted bright scenes (Fig:5.30) (Taylor 2001b:174).

The mummy and cartonnage belong to Padiamunet who was the attendant and door keeper of the god Ra at Thebes (Dawson & Gray 1968:14). He was also a barber at the temple of Ra (Taylor 2009a:573). Padiamunet held the same titles as his father, Usermose, whose name and titles were also inscribed on the case (Dawson & Gray 1968:14).

A set of two coffins belonging to Usermose, Padiamunet's son, is part of the collection of the Royal Museums of Art and History in Brussels⁵¹ (LaFee 2005) and a third and exterior coffin is in the Musée Curtius in Liège⁵² (Taylor 2009a:573). The style and decoration of Usermose's coffins (Fig:5.43) are contemporary with the style used during the end of the 25th Dynasty, more specifically around 20 years after the manufacture of Padiamunet's cartonnage case (Taylor 2011:per.com). The mummy of Usermose who held the same titles as his father, Padiamunet, has never been identified (Taylor 2011:Per. Com).

⁵⁰ The mummy and its coffin were part of Anastasi's second collection which was purchased by the British Museum in 1839 (Taylor 2009a:562).

⁵¹ The set of two coffins (International Inventory number 07/003/896- Inventory No MRAH E 5889B-C) house a 21st Dynasty female mummy (Huyge 2011:Per. Com, Taylor 2009a:564). More information on the coffins of Usermose in Brussels can be found in <http://www.globalegyptianmuseum.org/record.aspx?id=896>.

⁵² Inventory number Eg. 83A (I/628 A) (Taylor 2009a:570).

The mummy of Padiamunet travelled to the United States in 2005 as part of an exhibition called “Mummies:Death and the Afterlife in Ancient Egypt”⁵³. The mummy was CT scanned together with four other mummies from the collection of the British Museum. The results of the radiological investigation were never published in detail but one CT Image of Padiamunet was published by Taylor (2010a:59) who also mentioned briefly that the CT images showed a wooden pole (Fig:5.45) used by the embalmers to support the head and secure it in place⁵⁴ (Taylor 2010a:58). Taylor (2010a:58) also mentioned that the embalmers, faced with the difficulty of fitting the entire mummy inside its cartonnage case, left the wrapped legs exposed. This may indicate that the cartonnage case was not made especially for the mummy and that originally it may have been made to fit a different mummy which was then plundered and the case was reused to house the mummy of Padiamunet. It would be hard to believe that Padiamunet could not afford a specially made cartonnage case, bearing in mind that he belonged to the elite of Thebes. The case was extended to cover the lower legs and feet of the mummy but the extension had a rough finish. The extension was left clear of any plaster or paintings and mainly consists of a few layers of gummed linen which overlap the painted cartonnage in places (Fig:5.34). The original mummy wrappings are also visible in a few places at the bottom of the case (Fig:5.35). The wooden foot board which would usually seal the foot area has never been put in place as there was no space for it to be attached. Dawson and Gray (1968:14) suggested that the extension could have been added to house the packages which contain the internal organs but the X-ray images proved that it contains the feet⁵⁵. They also mentioned that the radiographs showed that the head of the mummy only reaches the shoulder level of the cartonnage, leaving a long empty space inside the case which suggests that the extension was unnecessary (Dawson & Gray 1968:14).

5.2.3.1 The decoration of the cartonnage:

The cartonnage is painted according to the style used during the 25th Dynasty (Taylor 2009a:574). Taylor (2003:105) attributed this cartonnage to Design I, based on the design of the frontal body area of the cartonnage case. However, most of the cartonnage cases that fall under this category belong to the early 22nd Dynasty.

⁵³ The mummy was part of an exhibition at The Bowers Museum, California from 2005-2008 (British Museum online Database). (http://www.bowers.org/index.php/art/exhibitions_details/18).

⁵⁴ This wooden pole was not reported by Dawson and Gray in their radiological report on this mummy.

⁵⁵ Possibly Dawson and Gray were referring to a suggestion by Birch (1879:59), who stated that “*some additional objects or portions of the body appear to have been placed at the feet*”

The body of the case is divided horizontally into four registers. Each register is divided vertically into three compartments. The artist used black and blue pigments for the inscription and blue, red, green and black pigments for the figures on the white background.

The first horizontal scene below the wide painted polychrome collar represents Padiamunet standing in adoration in front of Osiris and Isis (Fig:5.36). According to Taylor (2003:105), the main purpose of this scene, which represents a summary of the outcome of Spell 125 from The Book of the Dead, is to suggest that Padiamunet had passed the judgment successfully. A simple single black line of inscription mentions the name and titles of Padiamunet. The names of the deities are visible above the figures and also appear in detailed blue letters in front of each figure (Fig:5.32). All the figures are standing under the protection of the winged solar disk. This main scene is flanked by two symmetrical representations of the Four Sons of Horus, two on each side of the main scene, which, with reference to Spell 125, confirms that Padiamunet passed successfully to the afterlife (Taylor 2003:105).

Below this, there is a representation of Soker, the falcon deity; adjacent to this is the name Osiris Soker. Taylor (2003:105) noted that the representation of Soker is common on cartonnage cases.

Two compartments on each side of this scene are dedicated to vertical lines of inscriptions. Below that, a scene shows a large symbol of Abydos, the cult centre of Osiris, protected from both sides by the female deities, Neith (right) and Selkis (left). Each goddess is represented with her symbol above her head and her name inscribed in front of her figure and again on vertical lines of inscription at the top of the scene. Both deities are sitting on the symbol of gold or “*nebu*” which probably represents an association with Re as “The Mountain of Gold” is one of his titles (Wilkinson 1994:171). Both deities are facing away from each other and from the centre of the cartonnage. The Abydos fetish extends to the scene below and is again protected by two standing ram-headed deities. The name “Khnum” appears in front of one of the figures. On each side of this scene, there are three vertical lines of inscription. Two symmetrical figures of the recumbent jackal, representing the deity, Wepwawet⁵⁶, appear on both sides of the foot area of the cartonnage case. Four vertical lines of hieroglyphic

⁵⁶ Wepwawet was the deity of Lycopolis and was known as the “opener of the ways”; however, his well known protection of the dead was the reason for his representation on the cartonnage case (Lurker 2002:128-9).

inscription occupy the space between the jackal figures. Two long vertical lines of simple inscriptions run along both sides of the case between two red painted bands.

Padiamunet is represented wearing a black and white striped wig and the remains of a black painted scarab appear at the top of the head (Fig:5.42). Taylor (2009a:574) has suggested that the style of the inscription used on the cartonnage, especially the ending of the name of Osiris with the determinative of god “*nTr*”, indicates that the earliest likely date would be the reign of Piye, when the spelling of Osiris with the pennant sign first appears at Thebes, but it could be a little later, such as the reign of Shabaka which puts the date of this mummy towards the 25th Dynasty, at the end of the Third Intermediate Period.

5.2.3.2 Radiological findings:

Dawson and Gray (1968:15) reported a package of packing material in the lower abdomen and evidence of subcutaneous packing in the shoulder area⁵⁷. They also noted the absence of any amulets inside the wrapped body and a dislocated rib (Dawson & Gray 1968:15). No other abnormalities were reported with regard to this mummy.

⁵⁷ No X-ray images were published for this mummy in Dawson and Gray’s publication but a full set of X-ray images are stored at the British Museum, Department of Ancient Egypt and Sudan archives (Taylor 2010:Personal Communication).



Fig:5.29 Detail of the inscription on the cartonnage case of Padiamun, EA 6682. A black outline was drawn and filled with blue pigment on a white background.



Fig:5.30 Detail of a painted scene from the cartonnage case of Padiamunet (EA 6682). Only the scenes and their background were varnished in order to stand out while the inscriptions and their background were left unvarnished.



Fig:5.31 Detail of the titles of Padiamunet on his cartonnage case, EA 6682, “Attendant at the temple of the god Ra” (*Hry kAw n pr Ra*)



Fig:5.32 Detail of Padiamunet name on the coffin (PA di imnt) (in black) and the name of Osiris as it appears with a flag determinative (in red). Taylor (2009:574) suggests that this provide clear indication to the date of the cartonnage case and place it within the 25th Dynasty.



Fig:5.33 Detail of the titles of Padiamunet inscribed on the cartonnage case as the door keeper of the temple of god Ra at Thebes (*Hry iry aA pA Ra*)



Fig:5:34 Detail of the cartonnage plain undecorated extension that was added to house the lower legs and feet of padiamunet. The gummed linen overlaps the painted cartonnage in places.



Fig:5.35 Detail of the feet of the extension to the cartonnage of Padiamunet. The mummy wrappings are visible under the thin gummed layers of linen which had been added so the cartonnage would fully encase the mummy. No wooden base was used to secure the feet area of the cartonnage.

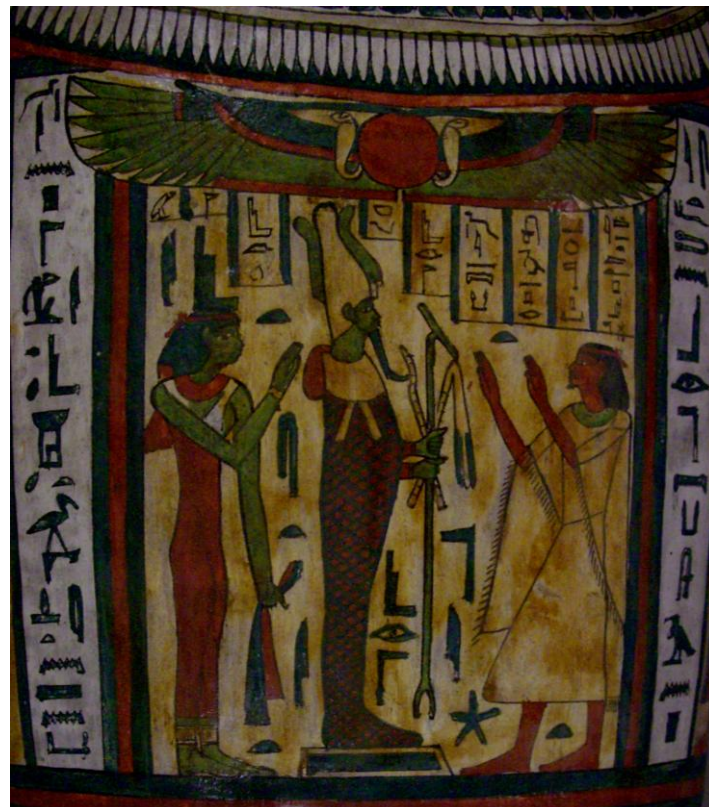


Fig:5.36 Padiamunet worshipping Osiris and Isis, painted scene on the cartonnage case. The simple inscription above the figures mentions the name and titles of the deceased together with the names of the deities which were also mentioned again in front of each deity in detailed blue letters.



Fig:5.37 Detail of the right hand side scene representing two of the Four Sons of Horus accompanied with an elegant inscription. Each is represented in the mummyform, holding the feather of Truth or Maat.



Fig:5.38 Detail of the lioness headed deity represented on both sides of the broad collar holding a bowl of incense and the ankh, the sign of life.



Fig:5.39 The Falcon deity, Sokar represented on the cartonnage case of Padiamunet



Fig:5.40 The symbol of Abydos protected from both sides by the female deities, Nieth (right) and Selkis (left), each represented with her symbol above the head and the name inscribed in front of her and again on the vertical line of inscription at the top of the scene. Both deities are setting on the symbol of gold or *nebu* which could be an association with Re as “The Mountain of Gold” is one of his titles (Wilkinson 1994:171).



Fig:5.41 The recumbent Jackal representing the deity Wepwawet, appears in two symmetrical scenes divided by four vertical lines of inscriptions at the feet of the cartonnage case.



Fig:5.42 The remains of the black scarab at the top of the cartonnage head. The photo also shows the lacing holes and the back slit that extends to the head area.



Fig:5.43 A set of two wooden coffins belong to Usermose, son of Padiamunet, in Brussels Museum (E5889). The mummy inside the coffins belong to a 21st Dynasty unidentified female.

<http://www.globalegyptianmuseum.org/record.aspx?id=896>
(accessed on 24/6/2011)



Fig:5.44 CT reformatted image of the mummy of Padiamunet (EA 6682) during the radiological investigation that was undertaken in 2005 during the exhibition at the Bowers Museum. The image shows the pole used by the embalmers to secure the head of the mummy.

(from Taylor 2010a:59).

5.2.4 EA 20744:Mummy and cartonnage case of Tjayasetimu:

This mummy (Fig:5.46) was acquired by the British Museum in 1888 (British Museum online database)⁵⁸. Taylor (2010:89) suggests that the mummy belongs to the 22nd Dynasty. The mummy was on display in the First Egyptian Room (Case K) in 1898 when the guide to the First and Second Egyptian Rooms was compiled by Budge (1898:28). He mentioned that the cartonnage was closed at the back using the usual lacing technique and a wooden board was attached to the foot area to secure the mummy inside the case. Budge (1898:28) also mentioned that the mummy was found at Deir El Bahari.

5.2.4.1 The decoration on the cartonnage case:

Tjayasetimu is represented on the cartonnage case with her right arm flexed on her chest and her left arm extended along the side of her body. The attached wooden lower right arm and left hand are unusual features that characterises this case (Taylor 2010:89). As a result of this unusual posture, which is similar to the Ramesside and the 21st Dynasty “daily life” coffin style (Cairo 29704 as an example Fig:5.57), Taylor (2003:107) assigned this coffin to the “*exceptional frontal designs*” category of cartonnage cases despite having common representations such as winged deities. A vertical line of inscription, the *Htp di nsw* formula, runs down the middle, dividing it symmetrically just below the abdomen. The wooden right arm was painted red and decorated with a black bracelet around the wrist (Fig:5.54).

Taylor (2003:107) compared this cartonnage case to another example from the Egyptian Museum, Cairo (JE 35055) which belonged to lady Tentkerer who lived during the reign of Osorkon I and is represented in the same posture as Tjayasetimu on her cartonnage case. Another example of a cartonnage case representing a female in the same “daily life” posture is in the Metropolitan Museum⁵⁹ (MMA 06.1232.1) (Fig:5.57) (Taylor:2009:390).

⁵⁸http://www.britishmuseum.org/research/search_the_collection_database/search_object_details.aspx?objectId=117342&partid=1&IdNum=20744&orig=%2fresearch%2fsearch_the_collection_database%2fmuseum_no__provenance_search.aspx

Dawson and Gray (1968:19) mentioned that the cartonnage was acquired in 1897.

⁵⁹http://www.metmuseum.org/works_of_art/collection_database/egyptian_art/cartonnage_of_a_woman/objectview.aspx?page=105&sort=0&sortdir=asc&keyword=&fp=1&dd1=10&dd2=0&vw=1&collID=10&OID=100008841&vT=1&iPage=1&hi=0&ov=0 (accessed on 7/7/2011). Taylor (2009:391) mentioned a Shabti statue (EA 56922) dates back to the 22nd Dynasty and holds the same “daily life” posture.

The cartonnage case was covered with a dark coating including the gilded face⁶⁰, the vertical line of inscription and the modelled feet (Dawson & Gray 1969:19). No dark material is visible on the sculptured wooden right arm, as the photograph of the mummy published in Dawson and Gray (1969:Pl X) shows. It is clear that sometime after Dawson and Gray's catalogue was published, cleaning took place to clear the gilded face, the central line of inscription and the modelled feet from the dark resinous layer⁶¹(Fig:5.47).

Dawson and Gray (1969:19) suggested that the case was made for an adult female while the mummy belongs to a girl, about twelve years old. They also noted the dark coating and suggested that it is black resin which would have been poured as a liquid over the painted case. The remains of the dark resinous material on the surface of the cartonnage case, particularly around the perforation for the wooden right arm, indicates that the liquid resin was applied first, and then the embalmers cut out an area big enough for the wooden arm to be attached. This hypothesis corresponds with Dawson and Gray's (1969:19) conclusion as they found the wooden painted arm to be free from any remains of dark resin. The same process was probably also used with regard to the wooden left hand which suggests that, during the manufacturing of this case, the core had to be modelled with the posture and wooden attachments in mind.

The dark coating was identified as bitumen by Budge (1898:28) and was also mentioned by Hammond (1959:44) who suggested that bitumen, from the Dead Sea, was used to cover the cartonnage case in order to protect the deceased because of the ancient belief in the powers of bitumen and its ability to repel enemies⁶².

Some details of the painting can be seen underneath the coating and in areas free from it. It is clear that the figures were painted on a white background which represents a dress that

⁶⁰ Budge (1898:28) also mentioned that the face was covered with the black coating suggesting that this was performed in order to obscure the inscription and to protect the mummy from being identified. He also identified the black coating as bitumen. Budge did not mention the name of the deceased as the inscription was still concealed in 1898.

⁶¹ Dawson and Gray did not mention the name of the deceased which indicates that the inscription was cleared sometime after 1968.

⁶² See further on coffins and cartonnage cases coated with dark resinous material, McCreesh, N. (2009) Ritual anointing: An investigation into the coatings applied to human hair and coffins in ancient Egypt, Unpublished thesis, University of Manchester. Also, Niwinski, A. (1992) Ritual protection of the dead or symbolic reflection of his special status in society? The problem of the black-coated cartonnages and coffins of the Third Intermediate Period. In, U. Luft (ed) *The Intellectual Heritage of Egypt*, Studies presented to Laszlo Kakosy by friends and Colleagues on the occasion of his 60th birthday, Budapest, *Studia Aegyptiaca* XIV.

terminates just above the modelled feet. The deceased is represented wearing a blue wig and the face is gilded (Fig:5.52).

A wide collar covers the top of the shoulders and the modelled breasts are covered with rosettes (Fig:5.56) similar to earlier examples from the Ramesside Period and 21st Dynasty. Winged figures cover the upper arms and four figures, probably the Four Sons of Horus, are represented on the abdomen, just below the left arm, two on each side. There is also a depression on the surface of the cartonnage to represent the navel. The line of inscription is surrounded by symmetrical winged figures; one of them appears to be a winged standing figure of Nephthys wearing a long garment which is visible above the right lower leg (Fig:5.50). Two red lines run along the edge on each side of the vertical back slit (Fig:5.58). The same feature can be seen in the cartonnage case of Djedamenufankh (EA 29577).

5.2.4.2 The line of inscription on the case reads (Fig:5.55):

*ḥtp di nsw Wsir Skr ḥr(y)-ib Styt.f ntr ʿ3 nb pt ḥk3 dt m Iwnu di.f mw n b3 ḥtp n ḥst mnḥt n s3ḥ
ḥst m ḥnw n Imn ʿ3j-ʿ3s.t-īm.w s3t P3 ḥ3rw m ʿ3 ḥrw r nḥḥ.*

An offering which the king gives (to) Osiris Soker, who resides in his Shetayt- shrine, the great god, lord of heaven, ruler of eternity in Heliopolis, that he might give water to (your) soul, offerings to (your) corpse and clothing to (your) mummy, singer of the interior of Amun, Tjayasetimu, daughter of Pakharu, true of voice forever⁶³.

Taylor (2009:398) points out that the phrase “water to the ba” was usually found in northern coffins while this coffin was found in Thebes. There are other examples of purely northern features that can be seen on coffins from the south such as the decoration on the hand which is called “gloves” and the representation of the jackal above the central vertical line of inscription which usually contain the *Htp di nsw* formula (Taylor 2009b:398). This indicates that some northern features and styles were used in Thebes and other southern provenances.

⁶³ I am grateful to Dr. John Taylor for his correction and comments on the transliteration and translation.

5.2.4.3 Radiological findings:

Dawson and Gray (1968:19) reported that the mummy belongs to a 12 year-old girl, based on the examination of the unerupted teeth in the mouth. They also reported that the mummy does not display any fractures or dislocations. The X-rays showed that the thoracic cavity did not contain any packages (Fig:5.59) and appears to be empty. Apart from some Harris lines on both ends of the tibia, Dawson and Gray (1968:20) did not mention any abnormalities detected during the radiological examination.

During the exhibition “Mummies: Death and the Afterlife in Ancient Egypt” at Bowers Museum, California, in 2005, a whole body scan of the mummy was produced using a General Electric lightSpeed CT scanner and high resolution 3D images were generated (Fig:5.48)⁶⁴. The CT images showed evidence of evisceration.

⁶⁴ This is an unpublished study and the information regarding the CT scans are from:http://www.gehealthcare.com/company/pressroom/releases/pr_release_10272.html (Accessed on 7/7/2011).



Fig:5.46 (EA 20744) Mummy and cartonnage case of Tjayasetimu
(from

http://www.britishmuseum.org/research/search_the_collection_database/search_object_image.aspx?objectId=117342&partId=1&orig=%2fresearch%2fsearch_the_collection_database%2fmuseum_no__provenance_search.aspx&numPages=10&idNum=20744¤tPage=1&asset_id=409775)

(accessed on 29/6/2011)



Fig:5.47 Mummy of Tjayasetimu before the cleaning of the face and the inscription line
(from Dawson & Gray 1969:Pl X)



Fig:5.48 3D rendered image of the mummy of (EA 20744) produced following the CT scanning examination of the mummy while on display at Bowers Museum in 2005.

(From <http://www.mtbeurope.info/news/2005/504017.htm>)

(Accessed on 29/6/2011)



Fig:5.49 The wooden foot board secured by wooden dowels to the cartonnage case (EA 20744).



Fig:5.50 (EA 20744) The painted cartonnage case of Tjayasetimu, the lines of dark coating show that the mummy was laying vertically while the liquid resinous material was poured over the surface of the cartonnage.



Fig:5.51 (EA 20744) Detail of the cartonnage case of Tjayasetimu showing the perforation of the cartonnage in order to attach the wooden right arm to the case. Remains of the dark resinous material indicate that it was applied first before the wooden arm was attached which corresponds with Dawson and Gray's (1969:19) conclusion as they found the wooden arm to be free from any remains of the dark coating.



Fig:5.52 (EA 20744) Detail of the gilded face and upper part of the cartonnage case



Fig:5.53 (EA 20744) Detail of the modelled feet and the line of inscription in the middle.



Fig:5.54 (EA 20744) Detail of the black bracelet represented on the wrist of the wooden right arm.

from

http://www.britishmuseum.org/research/search_the_collection_database/search_object_image.aspx?objectId=117342&partId=1&orig=%2fresearch%2fsearch_the_collection_database%2fmuseum_no__provenance_search.aspx&numPages=10&idNum=20744¤tPage=1&asset_id=409775

(accessed on 29/6/2011)



Fig:5.55 (EA 20744) the vertical line of inscription, *Htp di nsw* formula, starting just below the chest and extends to the feet of the cartonnage case. Black pigment was used on a white background. The inscription mentions the names of the deceased, Tjayasetimu and her father, Pakharu (𓂏𓂐𓂑𓂒).



Fig:5.56 (EA 20744) detail of the rosettes on the modelled breasts, the wide multicoloured collar on the shoulders and the attached painted wooden hand.

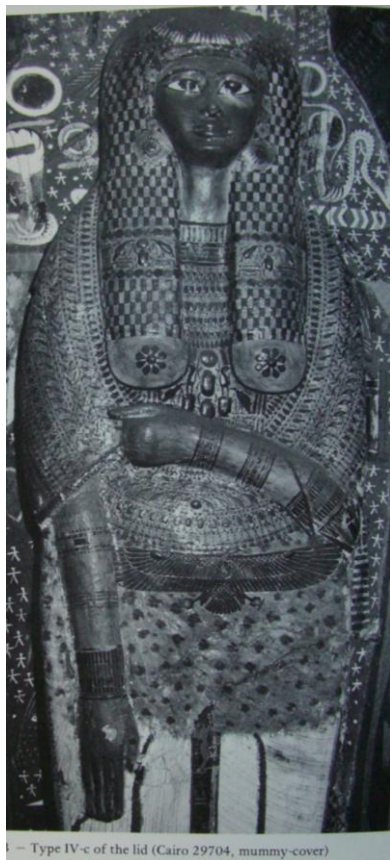


Fig:5.57 (black and white) (Cairo 29704) Mummy board. The deceased holds the same posture as Tjayasetimu in addition to the modelled breasts covered with rosettes which belongs to type IV-c according to Niwinski (1988:Pl XII).

(colour) Cartonnage case of a woman from Meidum in a similar pose as Tjayasetimu. The Metropolitan Museum, New York 06.1232.1.
(from Taylor 2009b:Pl VIII 2)



Fig:5.58 (EA 20744) detail of the cartonnage back slit with two red boarder lines run along each side. The same feature can be seen in the cartonnage case Djedameniufankh (EA 29577).

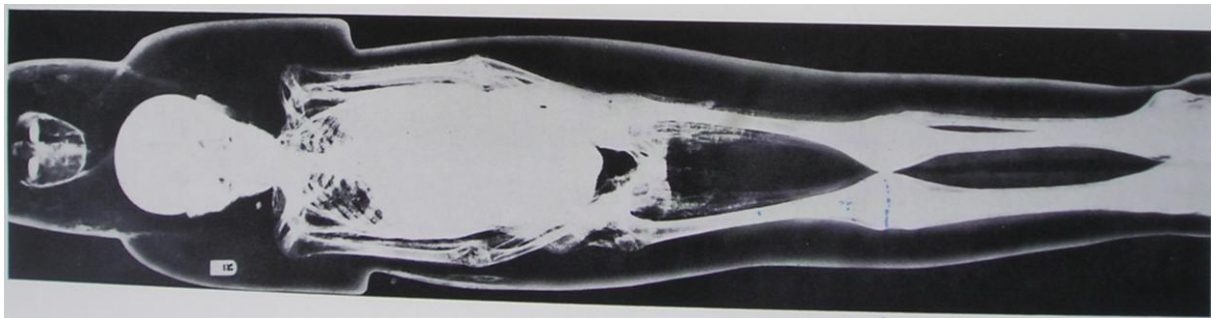
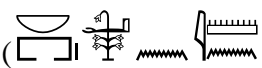





Fig:5.59 X- ray of Tjayasetimu taken by Dawson and Gray (1968:*Frontis Piece b*).


5.2.5 EA 22939: Mummy and cartonnage case of Tjentmutengebtui: ⁶⁵.

The mummy (Fig:5.60) was purchased by the British Museum from Raymond Sabatier in 1890⁶⁶ (the British Museum online database)⁶⁷. It dates back to the early 22nd Dynasty⁶⁸ (Taylor 2009b:402) and was found at Thebes (British Museum online database).

Tjentmutengebtui was a singer and priestess in the Temple of Amun () *nb(t) pr Smayt n imn*) while her father Khonsmes () was a *wab* priest () *wab n imn*) in the temple of Amun (Dawson & Gray 1968:8, Budge 1898:28). Her mother's name was also mentioned on the case as Mehenmut(em)hat () (Dawson & Gray 1968:8). The mummy was on display in case K in the First Egyptian Room in 1898, together with Tjayasetimu (EA 20744) (Budge 1898:28).

5.2.5.1 Radiological Examination:

Dawson and Gray (1968:8) reported the findings of the radiological examination of this mummy, carried out using portable X-ray equipment on loan from the Royal Marsden Hospital in London (Hughes 2010:236). Artificial eyes in the orbits and a number of amulets were visible in the radiographs. They also reported an oval plate incised with a *bnw* bird⁶⁹, a heart scarab and an incision plate which they suggested could have been made of metal or gilded wood (Dawson & Gray 1968:8). Subcutaneous packages and a number of fractures, although they did not suggest if they were post-or ante-mortem were observed in the X-ray images⁷⁰. They also noted a number of Harris lines on the tibia which indicates periods of ill health during childhood (Dawson & Gray 1968:8).

⁶⁵ The name was read as Tjent- Mut- s-Kebi 

⁶⁶ Dawson and Gray (1968:8) and Hughes (2010:235) mentioned that the mummy was acquired in 1891.

⁶⁷ http://www.britishmuseum.org/research/search_the_collection_database/search_object_details.aspx?objectId=117332&partid=1&IdNum=22939&orig=%2fresearch%2fsearch_the_collection_database%2fmuseum_no__provenance_search.aspx (accessed 7/7/2011).

⁶⁸ Dawson and Gray (1968:8) mentioned that the mummy belong to the 21st Dynasty.

⁶⁹ More likely to be a ba bird.

⁷⁰ Fractures in three ribs were mentioned by Dawson and Gray (1968:8) but these fractures were not observed during the CT scanning examination in 1994 (Hughes 2010:240).

In 1991, the mummy underwent another radiological examination using X-ray radiography and computer tomography at St. Thomas' Hospital, London ⁷¹(Fig 5.69) and the results were compared to the earlier examination⁷² (Baldock *et al* 1994:806-808). During this study 600 CT images of the full body were produced⁷³. Different slice thickness was applied to specific parts of the body, i.e., 2mm for the skull, 1mm for the teeth and 4mm for the rest of the body (Baldock *et al* 1994:806). The post processing of the images took place in Santa Clara, California and produced a number of 3D images of the teeth, the skull and the artificial eyes. A study of the attenuation numbers of the different objects found inside the wrappings was carried out and the numbers were compared with samples of a range of possible materials in order to identify the material of each amulet and object⁷⁴ (Baldock *et al* 1994:806). The study confirmed the brain had been removed through the ethmoid bone and a full study of the teeth suggested that the age at death was below 23 years (Baldock *et al* 1994:808), whereas Dawson and Gray (1968:8) suggested an age of between 25 and 40 years old. The 3D images of the head were used to produce a 2D reconstruction of the face (Fig:5.70) (Hughes 2010:235).

According to the mummification style of this period, all the internal organs except the heart were treated, wrapped and placed inside the body cavity. Baldock *et al* (1994:808) reported four packages; each contains a small figure which was probably made of wax, in the tradition of this period⁷⁵.

5.2.5.2 The decoration on the cartonnage:

The cartonnage case is brightly painted with different polychrome scenes following the southern style that was used in Thebes during this period (Fig:5.61) (Taylor 2009b:378). The scenes were painted on a grey background. The wig is represented in blue and decorated with yellow dots (Fig:5.62). An elaborate vulture headdress with two pairs of wings on each side is depicted above the wig. A winged scarab and the ba bird are represented on the neck and

⁷¹ The mummy was transported to the hospital five times in order to complete the radiological examination (Hughes 2010:239).

⁷² Tjntmutengebtui was the first mummy from the Egyptian collection of the British Museum to be examined using CT scanning techniques (Hughes 2010:235).

⁷³ Siemens DRH Somatom scanner (Siemens AG, Erlangen, Germany) was used to examine (EA 22939) (Hughes 2010:237).

⁷⁴ Baldock *et al* (1994:808) published a list of different materials and their attenuation numbers for comparison.

⁷⁵ Metcalfe (2007:282) mentioned Schmorl's nodes in the vertebrae of Tjntmutengebtui which indicates that she carried out manual duties during her lifetime. This observation was not mentioned by Baldock *et al* (1994:806-808).

between the lappets of the wig (Fig:5.63, 5.64). The deceased is represented wearing a wide polychrome collar that covers a large area of the chest. The cartonnage case is divided below the collar into horizontal compartments that have been filled with elaborate scenes. The first compartment below the wide collar depicts the deceased led by Horus who presents her to Osiris (Fig:.65, .66). This scene indicates that the deceased had passed the judgment successfully (Taylor 2003:105).

It is interesting to note that the scenes extend horizontally to cover all the visible area of the cartonnage including the sides of the case. The line that divides the front and the back of the case lay at a much lower point, providing a much wider area for each scene.



Fig:5.60 (EA 22939) The cartonnage case of Tjentmutengebtu

(from

http://www.britishmuseum.org/research/search_the_collection_database/search_object_image.aspx?objectId=117332&partId=1&orig=%2fresearch%2fsearch_the_collection_database%2fmuseum_no__provenance_search.aspx&numPages=10&idNum=22939¤tPage=1&asset_id=223518 Accessed on 7/7 2011)



Fig:5.61 (EA 22939) Cartonnage case of Tjentmutengebtu. The wig is painted blue and decorated with yellow dots. An elaborate headdress featuring two pairs of wings is also represented on top of the wig.



Fig:5.62 (EA 22939) Detail of the wig and the headdress from the side.

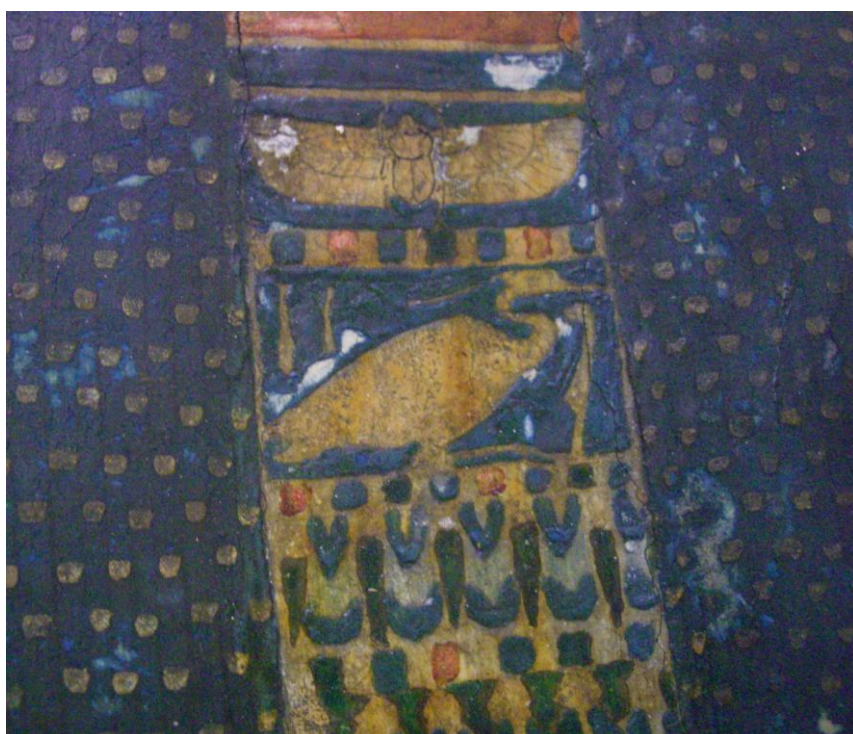


Fig:5.63 (EA 22939) Detail of the winged scarab, the ba bird and the feather of Maat between the lappets of the wing. All these symbols are to convey the idea that the deceased has passed the Judgment successfully and became true of voice or *MAa xrw* which in this case was inscribed as well above the tail of the ba bird.

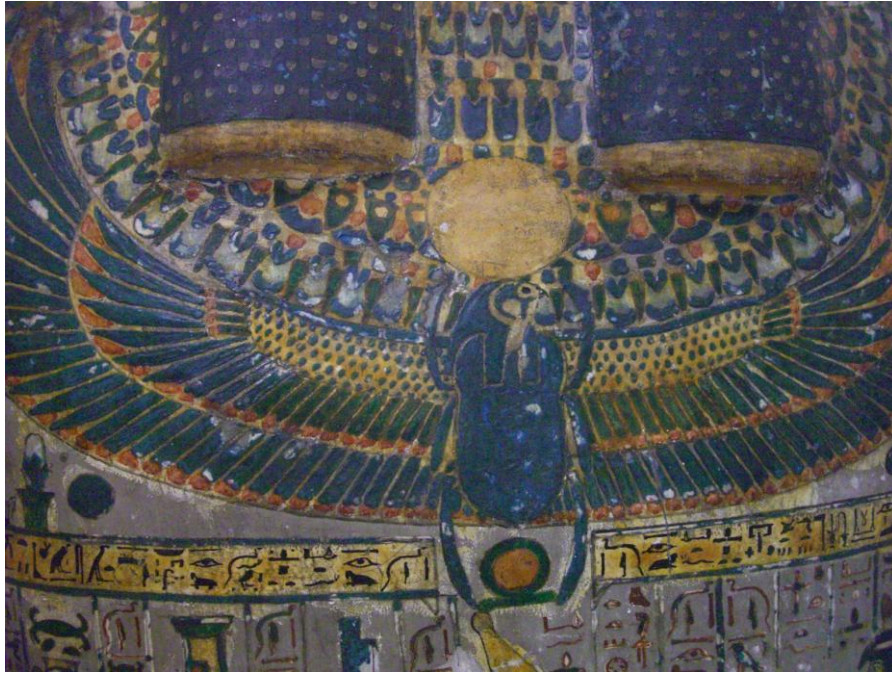


Fig:5.64 (EA22939) Detail of the falcon headed winged scarab with the sun disc over its head and the shen ring of eternity.



Fig:5.65 (EA 22939) Tjentymentgebtu led by Horus and presented to Osiris.



Fig:5.66 (EA 22939) Detail of the presentation scene showing a number of deities such as Thoth and one pair of the Four Sons of Horus.



Fig:5.67 (EA22939) Detail of the presentation scene showing a number of deities such as Horus, Osiris, Isis and Nephthys. The Four Sons of Horus are depicted on an altar in the shape of a lotus flower.



Fig:.68 (EA 22939) Detail of different protective deities such as Selkis, Bes and Neith.



Fig:5.69 (EA 22939) The cartonnage case and mummy of Tjetmutjengebtu during the examination in 1994. (from Hughes 2010:237).

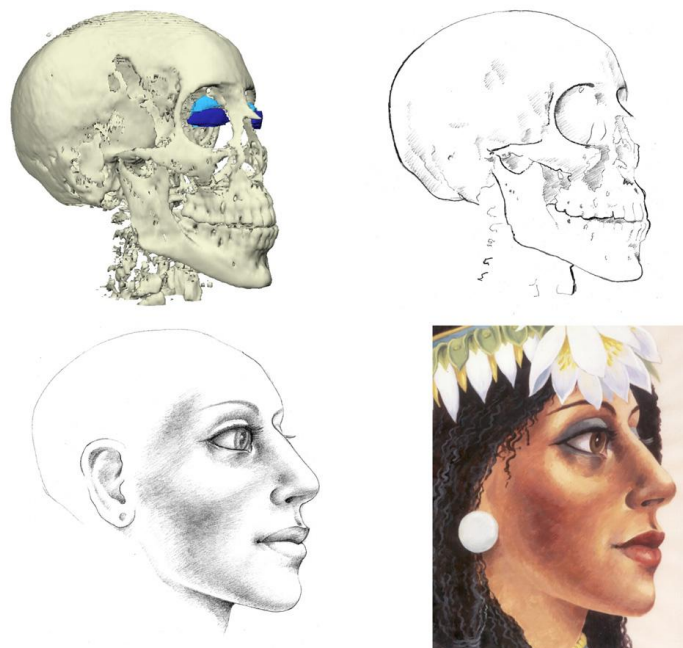


Fig:5.70 (EA 22939) the 3D reconstruction of the skull with the artificial eyes in blue and 2D artist's impression based on the outlines of the skull showing how she would have looked like during life (from Hughes 2010:241).

5.2.6 EA 25258: Cartonnage case and mummy of a priestess:

According to Budge (1898:31), this Theban mummy was on display in Case N in the First Egyptian Mummy Room, together with two other mummies. The mummy is encased in a painted cartonnage case (Fig:5.71) with a laced back and a wooden foot base. The mummy belongs to a priestess and singer in the Temple of Amun (Budge 1898:31, Dawson & Gray 1968:10). Her name is inscribed on the case but is illegible (Fig:5.77). The mummy, which dates back to the 22nd Dynasty⁷⁶, was purchased in 1894 from the auction house and dealers Rollin & Feuardent (British Museum online database).

5.2.6.1 The decoration on the cartonnage:

The polychrome scenes were painted on a white background. The deceased is represented wearing a plain blue wig (Fig:5.71). The face is painted a light yellow colour usually used for females. A wide elaborate collar is depicted on the chest. A ram-headed winged Horus is represented on the chest⁷⁷ (Fig:5.73). The usual *Htp di nsw* formula is inscribed on a long vertical line that extends from the abdomen to the foot area of the cartonnage (Fig 5.77). The wings of the protective deities depicted symmetrically on both sides, intersect and overlap each other and the inscription line but they do not obscure any part of the inscription (Fig:5.75). Some vertical columns usually used for inscriptions were left blank (Fig:5.76). Two symmetrical representations of Wepwawet as a jackal are depicted on both sides of the feet. The style of the cartonnage conforms to design 2B (Taylor 2003:105).

5.2.6.2 The radiological findings:

Dawson and Gray (1968:10) examined the mummy and reported that the X-ray images showed subcutaneous packing material around the neck and shoulders areas and a small scarab. They also reported that the deceased must have suffered some back pain due to a slipping in the fifth lumbar vertebra. A long rod in the abdominal cavity was visible in the X-ray images (Dawson & Gray (1968:10-11). It was suggested that the embalmers used the rod as a tool during the application of subcutaneous packing material and then it was left in the body by mistake (Dawson & Gray (1968:11). Small high density particles near the left hand

⁷⁶ Dawson and Gray (1968:10) mentioned that the mummy belong to the 21st Dynasty.

⁷⁷ See above for more information.

and on the left side of the pelvis were visible in the X-ray images but were not identified. One of the most interesting observations is the extraordinary treatment of the feet which had been disarticulated, probably long after the body was mummified (Dawson and Gray 1968:11) (Fig:5.78).



Fig:5.71 (EA 25258) Detail of the face, collar and winged solar ram-headed Horus.



Fig:5.72 (EA 25258) Detail of the top of the head area showing the upper part of the back slit and the lacing holes. No scarab was depicted on the top of the head.

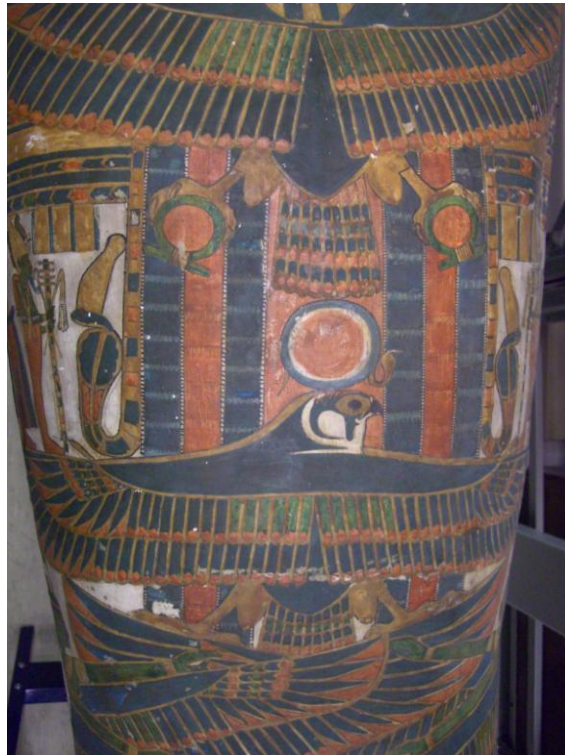


Fig:5.73 (EA 25258) Detail of the lower chest and abdominal area of the cartonnage case showing the winged falcon headed Horus stretching its wings to protect the deceased.



Fig:5.74 (EA 25258) Detail of the winged Nephthys depicted on the right side of the cartonnage.



Fig:5.75 (EA 25258) The lower part of the cartonnage case showing the symmetrical winged deities protecting the deceased. The wings intersect with the central line of inscription and overlap it in places however, it does not obscure it.



Fig:5.76 (EA 25258) Cartonnage case and mummy of an unknown priestess. The arrow points to the blank vertical lines which would usually contain inscription.



Fig:5.77 (EA 25258) Detail of the *htp di nsw* inscription on the cartonnage case.



Fig: 5.78 (EA 25258) The X-ray image take by Dawson and Gray (1968:Pl XXVIb) showing the unusual disarticulation of the feet.
(from Dawson & Gray 1968:Pl XXVIb).

5.2.7 EA 29577: Cartonnage case and mummy of Djedameniufankh:

The coffin and the cartonnage case (Fig:5.79, 5.80,5.83) were purchased by Budge in 1897⁷⁸ and were displayed in two separate cases in the museum in 1898⁷⁹ (Budge 1898:45, 68). Budge (1898:45, 68) mentioned that the coffin and mummy belong to the 26th Dynasty and that they were found in Thebes, while Dawson and Gray (1968:12) suggest that the ensemble dates back to the 21st Dynasty and that it was disturbed, looted, restored and rewrapped before it was placed inside the cartonnage. However, Taylor (2010:90) dates the mummy to the 22nd Dynasty⁸⁰.

5.2.7.1 The decoration of the case:

Djedameniufankh is represented on the case wearing a light and dark blue stripy wig (Fig:5.82, 4.95) and a polychrome wide collar that covers the shoulders (Fig:5.80). Varnish was applied to alternative layers of the collar (i.e. only to the layers that have red, blue and white squares) and the rest of the layers were left without varnish (Fig:5.81). The scenes represented on the cartonnage are closely related to the Book of the Dead. The scenes were painted on a blue background which is an unusual feature (Fig:5.85-5.94). The outline of the figures was done in black ink on a white background before the artist painted all the background areas in blue, occasionally overlapping and obscuring the black ink in places. A final layer of varnish was then applied to the figures only, giving them a hint of a yellow colour which contrasts with the blue background. The face was also covered with a thick layer of varnish. Detail of the unguent cone is represented on the top of the head and the back of the cartonnage has geometrical patterns representing a net bead (Taylor 2010:90) (Fig:5.84). The front of the cartonnage is divided into eight compartments, each containing a different scene. The aim of these scenes is to guarantee that the deceased passed safely to the underworld.

⁷⁸ The British Museum online data base mentions that Budge purchased the mummy from the Giza Museum.

⁷⁹ According to Budge (1898:45, 68) the coffin was on display in the first Egyptian mummy room in wall case 25 while the cartonnage case was on display in the second Egyptian mummy room, case V with another two Theban mummies (EA 6673 and EA 29778).

⁸⁰ The information on the British museum online database mentions that the mummy belongs to the 21st Dynasty.

5.2.7.2 The radiological findings:

The mummy which was thought to be of a female according to Budge (1898:45, 68) was found to be of a young male adult by Dawson and Gray (1968:12) who discovered the poor state of preservation, disturbance and disarticulation of the skull and upper body. It appeared from the X-ray images that the head (Fig:5.96) was upside down with a tooth and one artificial eye inside the skull. They reported that the mandible was missing. Lines of arrested growth were detected in both femora. The radiographs showed that the lower part of the body was in a better condition with articulated long bones (Dawson & Gray 1968:12).



Fig:5.79 (EA 29577) Cartonnage case and mummy of Djedamenufankh.



Fig:5.80 (EA 29577) Cartonnage case and mummy of Djedamenufankh.



Fig:5.81:Detail of the wide collar.



Fig:5.82 (EA 29577) Detail of the wig and the face.



Fig:5.83 (EA 29577) Detail of the various scenes on the cartonnage case of Djedamenufankh. The blue background is unusual but the subjects depicted in the scenes are traditional.



Fig:5.84 (EA 29577) view of the back the cartonnage case showing the geometrical pattern representing a bead net and the lacing used to secure the mummy inside the cartonnage case. (from Taylor 2010a:90)



Fig:5.85 (EA 29577) detail of the first register below the collar and the wig showing a *wDA* eye on each side of a papyrus column that is surmounted by a representation of Hathor in a human form. Two serpents wearing the white and the red crowns of Upper and Lower Egypt respectively, emerge from each side of the column.



Fig:5.86 (EA 29577) Detail of the first register below the collar. Two setting guardians of the netherworld are represented holding a knife for protection. Inscription squares were left blank above each figure.



Fig:5.87 (EA 29577) Detail of the second register shows the winged ram-headed scarab with the sun disc over its head and the Shen ring, the symbol of eternity, between its hind legs. On each side of the scarab, there is a representation of Wepwawet as a recumbent jackal with the flail and sceptre.



Fig:5.88 (EA 29577) Detail of the third register where the presentation scene is depicted. The deceased is led forward by Horus and an anthropomorphic deity to be represented to Osiris who is setting on his throne while Isis stands behind him. The mythical creature believed to eat the heart of the sinful is also represented as a combination of different animals such as crocodile, lion and hippopotamus.



Fig:5.89 (EA29577). Detail of the fourth register. The fetish of Abydos is represented in the centre of the scene flanked by two standards each holding a figure of Khnum who is represented as ram. The wedjat eyes appear on both sides of the standards. This ensemble is protected from both sides by a winged female deity holding the feather of Maat in her upper hand. The deity to the left is Isis with her name is inscribed in front of her and other deity to the right is Neith.



Fig:5.90 (EA 29577) Detail of the fifth register. The mummy of Djedimuniufankh is represented on the mummification bed while Anubis attends to the mummy to ensure its transformation into a *sAh* which is the perfect eternal image. Two canopic jars can be seen under the bed and the scene is flanked by two morning figures of Neith and Selkis.



Fig:5.91 (EA 29577) detail of the six register. The Djed Pillar, emblem of Osiris is depicted in the centre of the scene dividing it into two symmetrical parts. Wedjat eyes are represented on both sides of the pillar. Two winged solar falcons are represented on each side of the scene for protection. The inscriptions on the vertical columns next to the falcons are identical but face different directions. The inscription mentioned the name of the winged solar deity as Horus of Behdet.



Fig:5.92 (EA 29577) Detail of the seventh register. Hathor is represented as a cow crossing the delta marshes and Thoth is represented as a baboon with the solar disc on his head, squatting on a pedestal that resembles a gate. An obelisk appears behind Thoth and a sun disc with the Wedjat eye inside it.



Fig:5.93 (EA 29577) Detail of the eighth register. A serpent in the shrine is flanked by protective deities.



Fig:5.94 (EA 29577) Detail of the winged scarab depicted on the feet area of the cartonnage. The scarab is depicted to be seen by the deceased as looked at through the eyes of the cartonnage. A rectangle inscription area on the right side was left blank.



Fig:5.95 (EA 29577) Profile view of the cartonnage face.

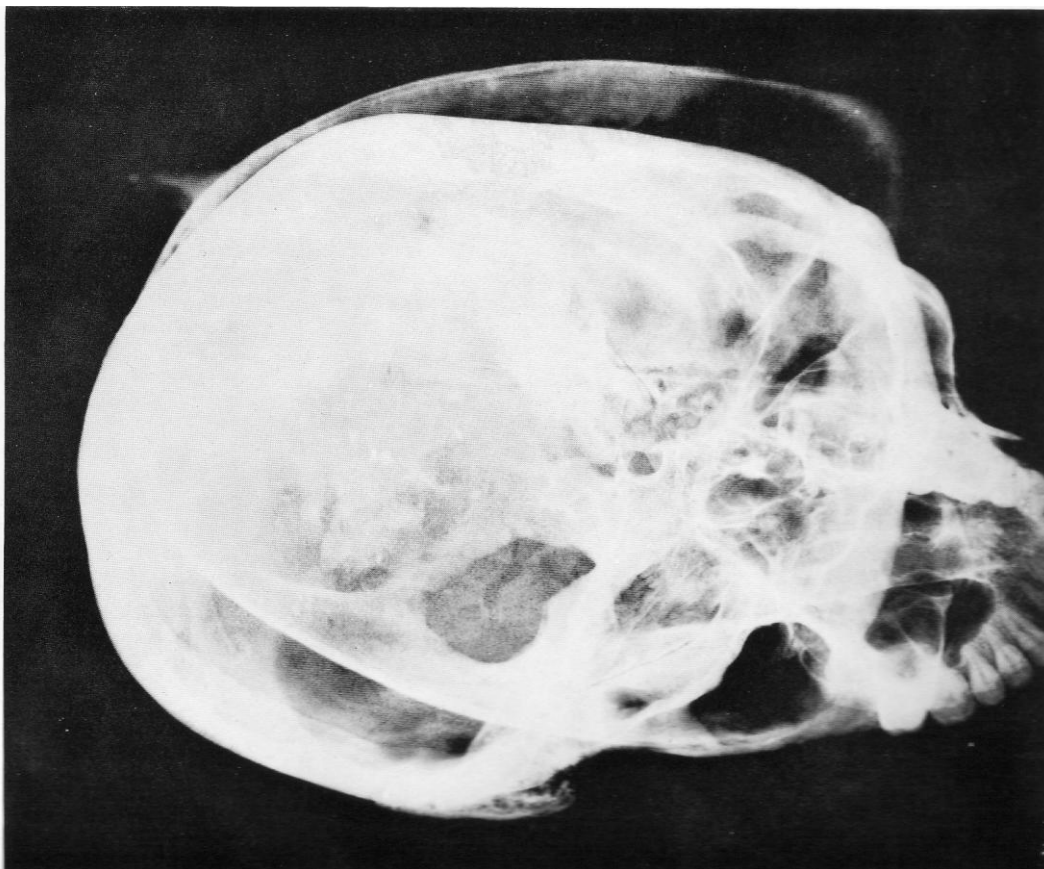


Fig:5.96 (EA 29577) X-ray radiograph of the disarticulated skull inside the cartonnage case (from Dawson & Gray 1968:Pl XXVIIa)

6 Chapter Five: Methods:

Advanced scientific techniques have helped greatly in the non-invasive investigation of wrapped Egyptian mummies throughout the last few decades. Unwrapping mummies physically is now considered a method from the past. In this research, only non-destructive methods were used to investigate the collection of mummies under examination. These include conventional X-ray techniques and Computer Tomography in addition to visual examination. It was suggested that DXA (Dual energy X-ray Absorptionmetry) could possibly be assessed as a new technique for examination of wrapped mummies but this did not take place due to technical difficulties.

The mummies were examined at the Manchester Royal Infirmary (MRI) in its state-of-the-art radiology department where the most sophisticated equipment is available. This allowed a range of examinations to be carried out.

6.1 Travel and Transport:

There is a total of nineteen mummies of the Third Intermediate Period at the British Museum (see table, Appendix V). Seven mummies were approved by the museum to travel to Manchester for examination and were transported on two occasions. The first group (EA 6681, 22939, 25258, 29577) arrived in Manchester on 7th May 2008 and were examined out of the regular working hours of the department which provides normal services for NHS patients. The mummies were divided into two groups and the examination lasted for two long sessions. The second group (EA 6659, 6682, 20744) travelled in August 2008 and went through the same procedure except that all three mummies were examined in one long session.

On both occasions, the mummies stayed in the hospital overnight and travelled back to the British Museum the following morning. A museum assistant accompanied the mummies during the road journey from London to Manchester and during the examination until the mummies went back to the British Museum. Experienced artefact moving personnel helped with unloading, moving the secure boxes through the hospital and lifting the mummies on and off the equipment platforms, for both CT scanning and X-ray radiography. The process was recorded by means of digital photography and video.

Each mummy was packed securely and safely inside a wooden box surrounded by its specially customised shell of protective material, to avoid any possibility of any damage to the mummies or to the fragile painted cartonnage cases. Each cartonnage case was placed on a modern wooden board for handling and lifting, and to avoid touching or putting any pressure on the cartonnage. Insurance was obtained and organised by the British Museum and the University of Manchester before transportation took place. The mummies were received at the hospital by a delegation of renowned professors, enthusiastic students and staff of the university, especially the KNH Centre.

6.2 Conventional X-ray radiography (plain radiography):

In December 1895, W. C. Röntgen, Director of the Physical Institute at the University of Würzburg and an experimental physicist, announced the discovery of the Roentgen Rays (Glasser 1933:28). The generated electromagnetic short wave energy rays can pass through many objects including the human body (Aufderheide 2003:377). Different materials would absorb the X-ray energy at different levels (rates). When the rays penetrate through an object, the emerging energy on the other side can be detected by light sensitive negative film as a shadow of the internal structure of this object which will appear in black and white on the film (Aufderheide 2003:377). The black areas on a radiographic image represent the high intensity of the X-rays as it went through the air or low density objects hardly unaffected. The white areas represent high density structures (such as bone) as most of the rays would be absorbed (Isherwood *et al* 1979:39). The quality of the X-ray image is greatly affected by what is called “X-ray quantum noise” which is the uncontrollable and variable number of X-rays that reach any one point on the sensitive film during an exposure (Shroy 2000).

The energy of the X-ray can range from one to hundreds Kiloelectronvolts (KeV) but a range between 5 to 150 KeV would normally be used for examination of human bodies (Shroy 2000). The X-rays in most modern equipment are generated inside a rotating anode X-ray tube (Shroy 2000). Accelerated electrons from an electrically heated filament in the cathode strike a small spot - to obtain sharp and focused images - on the anode or the target where they lose their energy. A high percentage of this energy will cause the anode to heat up and the remains of energy will be transformed into X-rays (Shroy 2000). The properties of the X-ray beam produced in the tube depend on the material of the anode (Shroy 2000) as well as

the number and speed of the electrons (Isherwood *et al* 1979:39). As the electrons hit the same spot of the anode (the focal spot less than 1mm²), which would cause it to deteriorate very quickly or melt, the rotated anode is introduced so X-rays will be produced from different focal spots of the anode (Shroy 2000). A very large voltage difference between the anode and the cathode also encourages the electrons to leave the filament and hit the anode. This voltage (KeV) is provided by a generator which controls the flow of electrons from the cathode to the anode by controlling the time and their amount (Shroy 2000). The parameters of any X-ray exposure should contain the peak KeV in addition to the milliamperere per second which is the current flow per second (Shroy 2000).

The images produced are 2-dimensional images so internal body structures can be overlapped or obscured by other structures or even radiopaque materials, such as sand or resin, that have been introduced to the specimen during mummification or later (Aufderheide 2003:377). The image produced is a record of everything the rays go through till they reach the sensitive film (Filer 1995:47).

This study was conducted using the X-ray computed radiographic (CR) equipment (Philips Medical System, Best, Netherlands), with a focal spot size of 0.6mm. The radiographic factors used to obtain the radiographs of the mummies were adapted from those used routinely for imaging human patients.

After the mummies arrived at the MRI, conventional X-ray examination of each mummy took place. Each mummy was X-rayed in antero-posterior (AP) using exposure factors approximating to those used in clinical practice, with the exception of the feet and the cranium (Table 6.1).

Body Part	AP		Lateral	
	kVp	mAs	kVp	mAs
Cranium	77	32	66	32
Torso	90	24 with grid	90	60
Humeri	70	10	n/a same image as torso	
Abdomen	77	32 with grid	90	32
Pelvis	77	40	n/a same image as abdomen	
Femur	70	10	80	24 superimposed anatomy
Knees	70	6.3	77	24 superimposed anatomy
Ankles	70	6.3	70	12 superimposed anatomy
Feet	70	6.3	70	12 superimposed anatomy

Table 6.1: The exposure factors used during the X-ray examination. The distance between the film and the object (FOD) ranged between 10 to 30 cm. The film focus distance (FFD) increased between 150 and 200cm to reduce magnification.

The material of the cartonnage was thicker in the cranium and feet areas; so that a higher kVp had to be used to increase X-ray penetration and commensurately higher mAs was used to provide adequate image contrast. This in addition to the unusual location of the skull and the feet of some mummies which caused some difficulty in obtaining clear and exact AP or LP images. For example, in the mummy of Djedamuniufankh (EA 29577), the skull was dislocated and placed upside down, and in the mummy of Tjentmutengebtu (EA 22939), the head is slightly tilted to the right⁸¹. Grids were used for the torso and pelvis, as they would be in general clinical practice.

X-ray radiographs were also taken in the lateral positions (LP) (Fig:6.1) which were obtained using similarly higher exposure factors to compensate for the superimposition of anatomical structures and the attenuation of X-rays by the cartonnage. In clinical practice of human patients when performing a lateral projection of the torso it is possible to move the arms out of the field of view, and if performing lateral views of the legs each leg would be imaged separately to avoid overlap. However, this is obviously not feasible when imaging mummies which are fixed in position. Grids were not required for the lateral images, the scatter from the higher exposures being compensated for by the 'air gap' between the cartonnage and the image receptor (IR) plate. As it was not possible to position the IR as close to the area of study (the object to film distance) (OFD) as can be achieved in clinical practice, it was necessary to increase the focus to object distance (FOD) to reduce the geometric magnification.

The X-ray cassettes were read on site using a Philips PCR AC 5000 reader unit and were digitized and saved as JPEG images to allow further examination and study on a normal PC. During the examination, the X-ray images were instantly checked using the screen attached to the Philips PCR reader unit to ensure the high quality of each radiograph. This also provided a chance to carry out initial observations on the X-ray images on site.

⁸¹ I am grateful to all the technicians and radiography specialists who assisted during this study. They worked after normal hours and showed no signs of boredom or tiredness. They demonstrated great interest in the subjects of this study during all the radiographic sessions. The team of radiologists was led by Prof. Judith Adams who shared her wide knowledge and experience during the examination. This resulted in producing the highest quality of images that can be obtained.



Fig:6.1 The mummy of Payeftjauemawykhons (EA 6681) during a lateral position view of the skull using the X-ray equipment.



Fig:6.2 The CT scanning machine used during this study (General Electric Lightspeed-Pro 32).

6.3 Computed Tomography (CT):

Computed tomography is a computerised technique that produces tomographic images. The computer axial tomography was developed in the early 1970s by Dr. Godfrey Newbold Hounsfield. It has been considered to be the most useful non-invasive technique in the scientific study of mummies (Cunningham 2000; Münnemann *et al* 2007:1341). Hounsfield and Halmshaw (1979:223) explained that the best illustration of a three dimensional object should be with a three dimensional picture. In September 1973, an article in the *Science News* announced how the new technology could be used to examine the brain in thin cross sections (Anonymous 1973:134). Sensitivity is one of the advantages of this technique as it demonstrates accurately and with a high level of clarity the soft tissue and allows its nature to be studied by measuring various values of X-ray radiation absorption (Hounsfield & Halmshaw 1979:223; Edholm 1977:277). It provides a solution for the mathematical problem of creating three dimensional images from their projections (Edholm 1977:277). Another advantage of the CT scanning images is that it eliminates superimposing, which is the main problem of X-ray radiographs, as mentioned above (Aufderheide 2003:379). On the other hand, conventional X-ray radiography produces sharper images as the contrast resolution is better in the radiographs (Adams 2004:Per. Com).

The CT scanner consists of an X-ray tube as the source of radiation, exactly the same as the conventional X-ray machine (Wong 1981:101). The radiation from the X-ray beam goes through the different materials of the specimen under examination, such as bone, fat, muscle, and wrappings, with different rates according to their density (Wong 1981:101). The radiation energy will then be absorbed by the ionisation or scintillation detectors which transform it into electrical signals (Cunningham 2000). The radiation beam and the detectors are both fixed to the same frame and rotate around the specimen which is usually lying on a movable platform (Wong 1981:101; Hounsfield & Halmshaw 1979:223). The changes in the X-ray energy that are received by the detectors can be analysed and displayed on a computer screen (Wong 1981:101). The computer software stores and processes the data (the X-ray transmission measurements) sent by the detectors and produces a transverse sectional or axial image of the part of the body under examination (Wong 1981:101). Hundreds of measurements can then be processed to construct a high resolution tomographic image of the specimen (Cunningham 2000). Series of cross section thin slice images or “segments” can be manipulated to produce a three dimensional reconstruction of the whole specimen

(Hounsfield & Halmshaw 1979:223). The thickness of each slice can vary from less than 1 mm to any required thickness (Aufderheide 2003:379). The slices can be joined together, providing three dimensional images in any required plane (i.e. sagittal, cross section, etc) (Aufderheide 2003:379). This technology became available in 1986 when John Stevens and Judy Trogadis of the Toronto Western Hospital, Canada, developed vital software that transforms sequential CT sections into stereoscopic or three dimensional images (Lewin 1988:1249).

CT Scanners have improved greatly since the 1970s. The number of detectors has increased from 30 to 64 and the use of a dual energy source instead of just one X-ray radiation source has enhanced the soft tissue depiction, improving the quality of the images and reducing the scan time (Cunningham 2000). A whole body scan can be achieved in minutes, using a fast helical CT scanner (Aufderheide 2003:379). Advanced computer science and sophisticated software offer easy manipulation of images and a wide range of effects that can be controlled, such as density ranges and edge difference enhancement which can assist in the identification of amulets and artefacts within the wrappings (Aufderheide 2003:379). All the disadvantages of computer tomography mentioned by Edholm (1977:278), such as un-sharp images, high noise levels and long examination time have been overcome (as he predicted) except for the high price of the equipment.

A full body scan of each of the selected mummies was carried out after calibration and preliminary scout anteroposterior and lateral images were obtained, and used to identify the location of each mummy within the cartonnage case or the wrappings. The thickness of each axial image ranged from 0.625mm to 0.6 mm throughout the examination. The same slice thickness was used throughout the body under examination, unlike previous studies (for example, Cesarani *et al* 2003; Marx & D'Auria 1986; Baldock *et al* 1994).

The scanner used during this study was a General Electric LightSpeed Pro 32 row multi-detector CT (MDCT) scanner⁸² (General Electric, Milwaukee, USA) (Fig:6.2). Helical volumetric scans were obtained using 120 kVp, 200 mA, a pitch of 0.969:1, rotation of 0.6 seconds giving a slice thickness of 0.625mm. The number of slices performed for each

⁸² For more information on the specifications of the CT scanner see the evaluation report published by the Purchasing and Supply Agency, Centre for Evidence-based Purchasing, NHS: <http://www.impactscan.org/reports/Report05068.htm> (Accessed on 16/7/2011).

mummy varied from 2443 to 3000. Images were sent to PACS (picture archiving and communications systems) and stored. Images were viewed at lung (window width = 1465 Hounsfield Units [HU]; window level = - 498 HU) and bone (window width = 3077; window level = + 570HU) levels or variations of these imaging factors. Selected reformations were obtained, but if these were performed on the entire large number of sections this occasionally caused the system to crash.

6.4 Examining the Images:

For post processing, the axial CT images were transferred to the workstation. A copy of the images was saved on a number of CDs for further examination of the X-rays, CT images and reformatting. The images were saved as DICOM files and a small software reader was installed on each CD to allow reading from a normal PC. The images of each mummy were saved on an average of six full CDs, providing a very large amount of data.

Measurements were taken from the axial and scout images as the CT scanner was calibrated to produce scout images with no magnification (Adams 2010:Pers. Com). The measurements were taken using the application in the viewer software. Hounsfield Unites (HU) were recorded for amulets and foreign objects found within the wrappings. A few sets of metric measurements were obtained from the CT images for different purposes.

A protocol for examining and recording the finds and measurements was put together based on previous studies and publications such as Aufderheide (2003) and Buikstra and Ubelaker (1994) *Standards for Data Collection from Human Skeletal Remains:Proceedings of a Seminar at the Field Museum of Natural History* (Arkansas Archeological Report Research Series), the Arizona State Museum Skeletal forms and guidelines⁸³.

⁸³ A copy of the guidelines can be accessed at:
http://www.statemuseum.arizona.edu/crservices/burial/hum_rem_inventory.pdf

6.5 Physical Anthropological examination;

6.5.1 Sex determination:

Physical anthropological standards and interpretations were used to determinate the sex and age at death. Non metric techniques were used to establish the gender of each individual. Examination of the images of the pelvis and the skull⁸⁴ were used for sex determination⁸⁵ as these are considered most reliable for sex prediction and both were available for all our subjects. For sub-adults, the pelvis and the teeth were examined (see Alt *et al* 1995 & Rösing *et al* 1995).

Widely accepted morphological pelvic⁸⁶ and skull characters⁸⁷ were chosen and examined from the radiographs (Fig:6.3, 6.4), CT scans and 3D reconstructions. Other traits such as the maximum diameter of the humeral head were used occasionally to confirm the sex already determined from the pelvis and the skull (Fig:6.7, 6.8, 6.9).

A number of physical anthropological standards were used to confirm the sex determination including recommendations by the Workshop of European Anthropologists that were formulated in 1980 by D. Ferembach, I. Schwidetzky and M. Stloukal⁸⁸. The recommendations by Rösing *et al* (2007) were also consulted for sex determination. A more recent study of sex determination from CT images was consulted. Decker *et al* (2011) examined the 3D reconstruction of the pelvis of 100 living individuals for sex determinations. During that research, the team explored the possibilities of using new landmark points and new measurements on the pelvis for both osteometric and non-metric studies (Decker *et al* 2011:3).

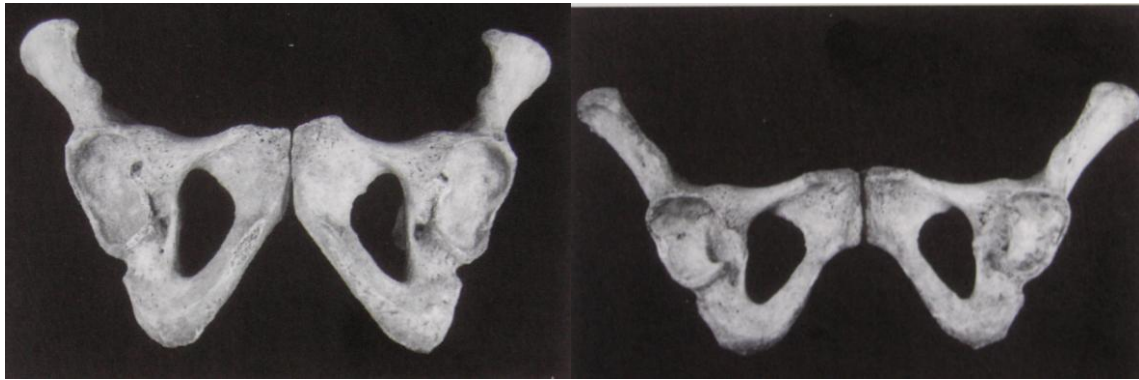
⁸⁴ Accuracy of sex determination from the pelvis alone is 95%, from the skull alone is 90% and from both together 98% (Roberts 1996:107).

⁸⁵ Various studies for sex determination from other parts of the skeleton such as the patellae (with success rate 83.8%) (Introna *et al* 1998), the metatarsal (study was done on Egyptian population from X-ray images and resulted in 85.6% accuracy) (Abdel Moneim *et al* 2008), the femoral head (Asala 2001, Purkait 2003), the metacarpals (Lazenby 1994, Zanella & Brown 2003), the sternal end of the ribs (Kocak *et al* 2003), the clavicle (Introna *et al* 1994), the sternum (DiVella *et al* 1994), humeral head (Stewart 1979:100) were carried out but are mainly to be used when the pelvis and the skull are not available for study or for additional confirmation.

⁸⁶ Examples of the areas examined are; the pelvis inlet shape, subpubic angle, obturator foramen shape and sciatic notch (Ferembach *et al* 1980:315).

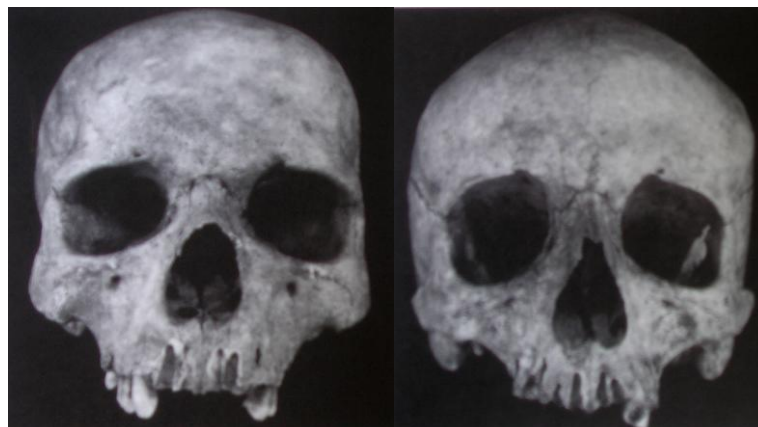
⁸⁷ Examples of areas of the skull studied for sex determination are: glabella, mastoid process, zygomatic process, mandibular angle and the total aspect of the mandible (Ferembach *et al* 1980:325).

⁸⁸ These recommendations were published in 1980 in the *Journal of Human Evolution*.



	Male	Female
Pubic bone	shorter	longer
Subpubic angle	narrower	wider
Subpubic concavity	absent/rare	present
Ventral arc	absent/rare	usually present
Ischiopubic ramus	wide	narrow
Sciatic notch	narrow	wide
Preauricular sulcus	less common	more common
Pelvic basin	heart-shaped	circular, elliptical
Obturator foramen	oval	triangular
Sacrum (lateral)	curved	flatter

Fig:6.3 The characters of the male and female pelvis used for sex determination. (from Roberts 1996:107).



	Male	Female
Supraorbital ridges	prominent	less prominent
Frontal sinuses	larger	smaller
Superior orbit	blunter	sharper
Muscle ridges	more prominent	less prominent
Frontal bone	sloped	more upright
Zygomatic process/ extension to supra meatal crest	yes	no
Mastoid process	larger	smaller
Anterior mandible	square	pointed
Cranial capacity	larger	c. 200cc smaller

Fig:6.4 The characters of the male and female skull used for sex determination. (from Roberts 1996:108).

Schutkowski's (1993) recommendations were used to determine the sex of one mummy during this study that proved to be a sub-adult (EA 20744). Scheuer and Black's (2004) extensive study of juvenile skeletons was also consulted, especially regarding the different fusion times of the pelvis seen in males and females which can be used for sex determination. Hillson (1986:145) points to another sex indication method through examination of the distribution of tooth sizes which can be applied to permanent and deciduous teeth. He also points to the importance of this method for sex determination in juvenile skeletons (Hillson 1986:145).

When estimating the gender, evidence from the radiographic images of the mummy, such as the presence of a penis, was also taken into account. The estimated sex was also compared to the name and short biography inscribed on the mummy case, when available.

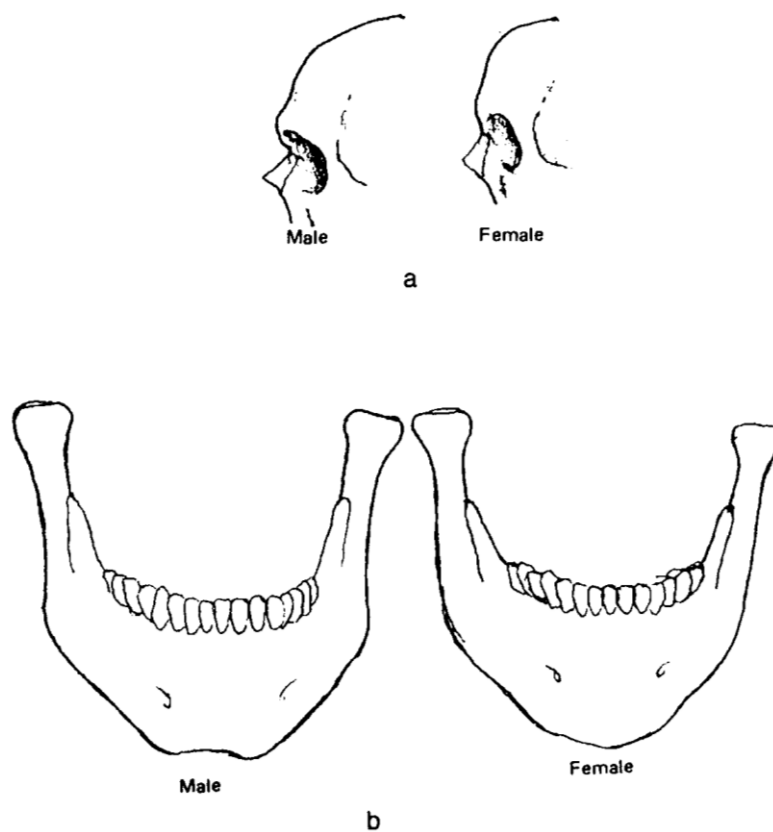


Fig:6.5 Characteristic traits used for sex determination from the skull, such as the brow ridge, forehead and the shape of the mandible.

(from Bass 1995:87)

Age	Stature (cm)		Femur (cm)		Tibia (cm)		Skeletal Age (Years)	
	Mean	σ	Mean	σ	Mean	σ	Mean	σ
8	128.1	4.78	33.1	1.63	26.3	1.39	7.6	1.02
9	133.8	4.78	35.0	1.71	28.0	1.50	8.7	1.02
10	139.9	5.24	37.0	1.82	29.8	1.67	9.9	1.03
11	146.6	5.93	39.2	2.00	31.6	1.84	11.1	1.07
12	153.2	6.36	41.1	2.12	33.2	1.95	12.5	1.12
13	158.3	6.14	42.4	2.12	34.2	1.94	13.8	1.06
14	160.8	6.16	43.1	2.15	34.5	1.97	14.8	1.05
15	162.3	6.02	43.2	2.18	34.6	1.98	15.8	1.00
16	162.9	6.10	43.3	2.20	34.6	2.00	16.4	0.92
17	(163.8)	(6.37)	(43.3)	(2.21)	(34.7)	(2.00)	(17.1)	(0.85)
18	(164.9)	(6.10)	(43.3)	(2.21)	(34.7)	(2.00)	(17.8)	(0.46)

Fig:6.6 Actual and estimated age of girls based on measurements of the length of the tibia and the femur.

(from Anderson *et al* 1963:3)

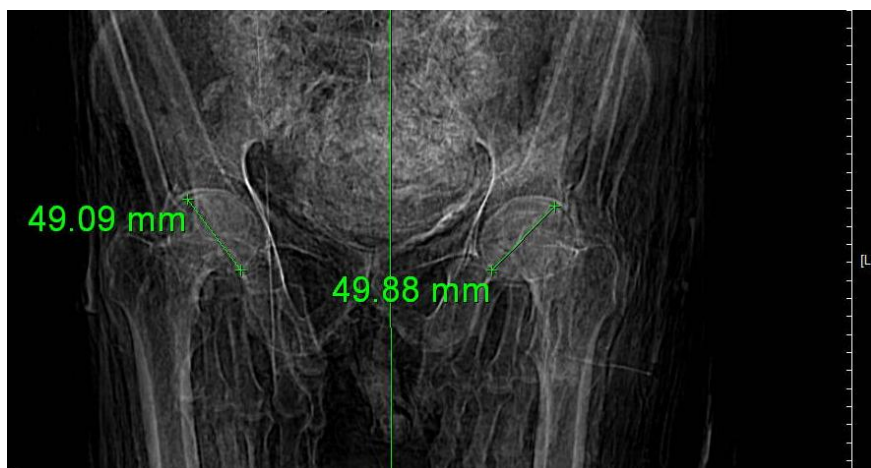


Fig:6.7 Example of the measurement of the femoral head to confirm the sex determination (from the scout image of EA 6659).

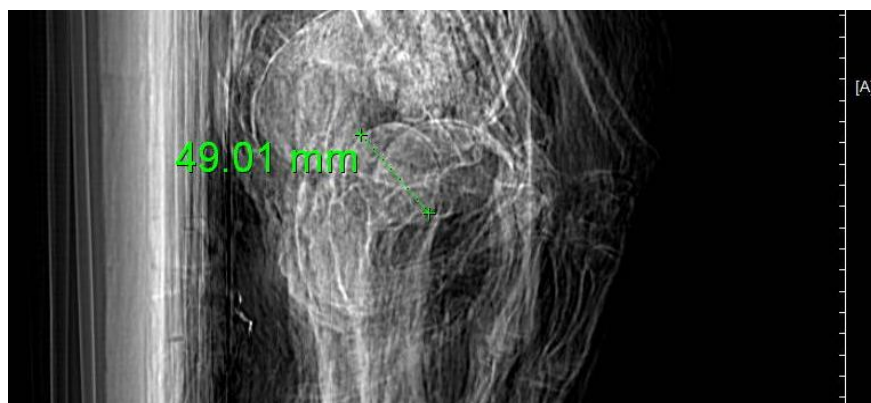


Fig:6.8 Measurement of femoral head confirmed from the LP scout image (EA 6659).

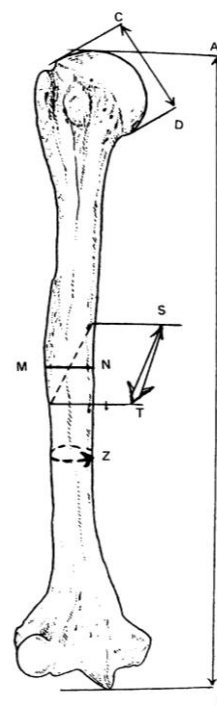


Fig:6.9 The measuring points of the humerus showing C-D, the maximum diameter of the head which can be used as sex indicator.
(from Bass 1995: 153)

6.5.2 Estimation of Age at Death:

Age estimation is based on the examination of the biological changes that take place during life and can provide evidence regarding the age of the individual at death (Bass 1995:12). The first study in this field was undertaken in 1920 by T. W. Todd who studied the age related changes in the pubic bone in the white male American population⁸⁹.

A range, rather than a specific number of years, is always given when estimating age; this should allow a degree of accuracy based on many factors such as the stage of development of the individual. A more specific age can be estimated for younger specimens (under 25 years old). Teeth eruptions, fusion stages and length of long bones (without the epiphyses) can provide more accurate estimation as each takes place within a relatively shorter period of time. However, estimation of the age of skeletons of older individuals is mainly based on levels of dental attrition and degenerative alterations to the skeleton (Fig:6.11) (Bass 1995:12).

X-ray, CT images, reformates and 3D images were used to assist in age estimation for all the subjects of this study (Fig:6.10, 6.11). Fusion levels or degrees of epiphyses at the end of the long bones (epiphyseal closure patterns) as well as the teeth eruption⁹⁰ and pelvic bones were used for estimating the age at death for sub-adults (EA 20744).

For the adults, a combination of factors, such as dental attrition and development of osteoarthritis, osteoporosis and arteriosclerosis (calcification in the walls of arterial blood vessels), were carefully considered. An overall estimated age at death was based on these factors which provide a combination of the dental and skeletal age at death. Physical anthropological standards for classification of dental attrition phases (Fig:6.14), given by Brothwell (1981:72), were used as a guide in the estimation of dental age at death.

⁸⁹ This was followed by another study in 1935 by Kronfeld who conducted a histological and radiographic survey to establish stage developments in teeth formation (Bass 1995:12). One of the most important studies in age estimation was conducted by McKern and Steward in 1957 on the bodies of American soldiers who died during the war in Korea.

⁹⁰ Hillson (1986:146) points to factors that affect teeth eruption, such as gender, diet and ethnic background, in addition to other economic factors.

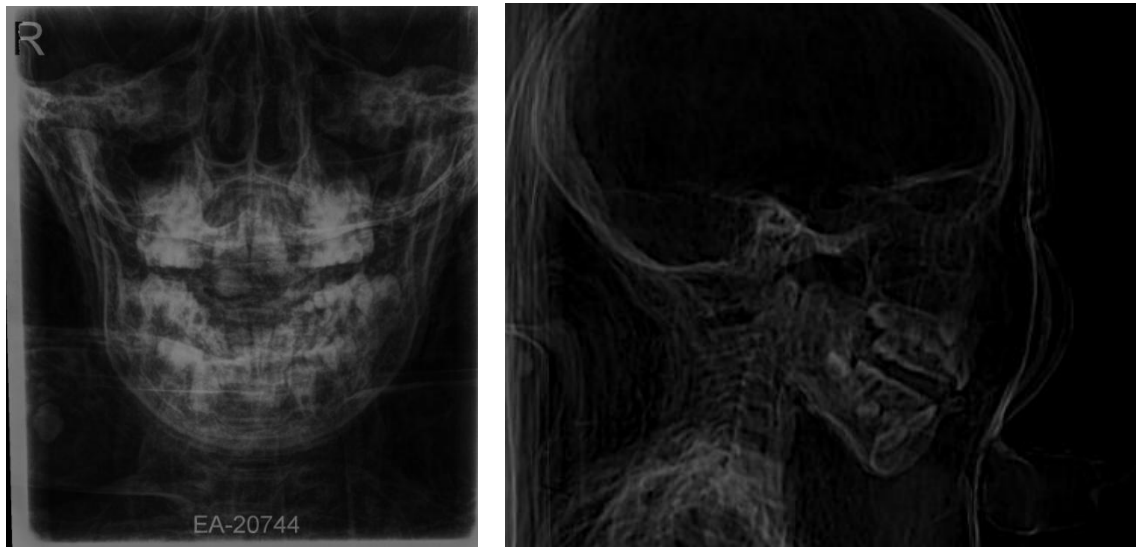


Fig:6.10 X-ray and CT lateral scout image of (EA 20744) clearly showing the unerupted teeth allowing age estimation.

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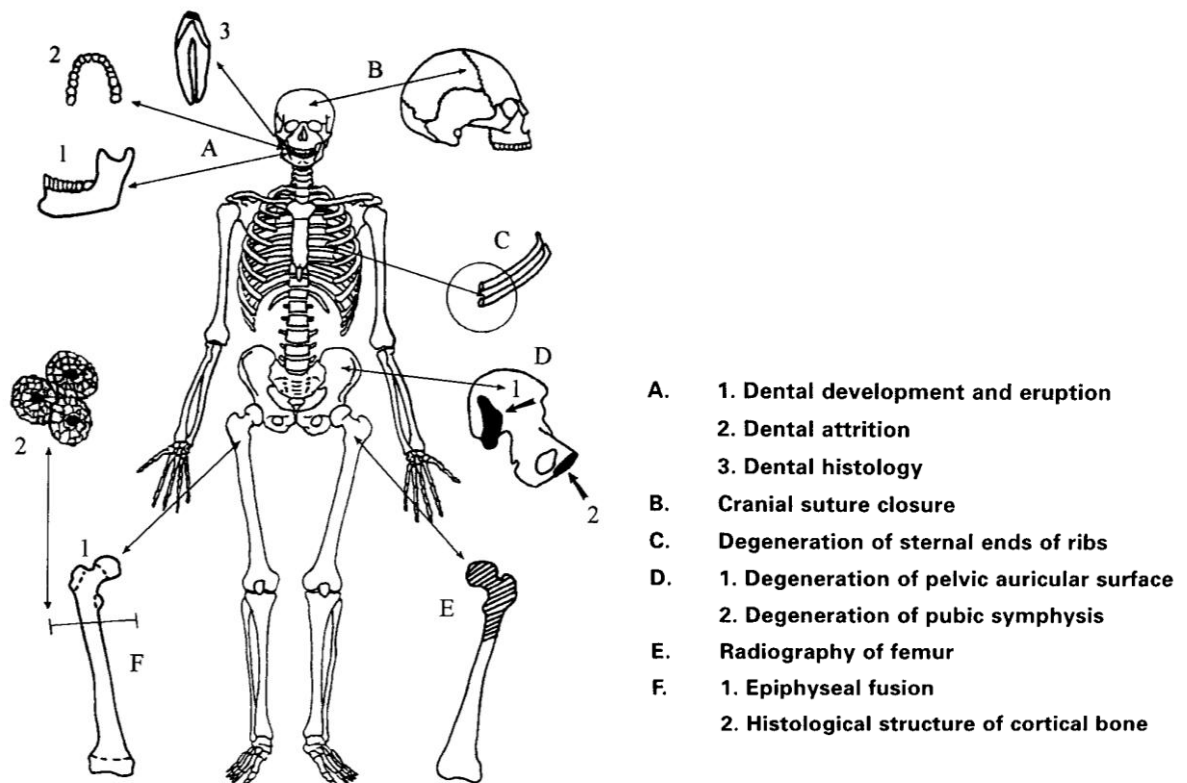


Fig:6.11 Cranial and skeletal areas used for aging adults.
(from Roberts 1996:112)

6.5.3 Stature Estimation:

The history of estimating the stature from the long bones goes back to the 19th century (Bass 1995:26). The first trials were based on ratio and then a number of equations were published by Karl Pearson in 1899. This publication includes the results of an experiment that was conducted by Ernest Warren to observe the changes in the length of two femora from Naqada which had been rehydrated and then dehydrated again (Pearson 1898:244). Warren also published a study on the skeletons discovered at Naqada by Petrie and noted that the measurements of the long bones, especially the tibia and radius, are similar to those of the French population (Warren 1897:139). He concluded that the Naqada skeletons belong to a “hardy and vigorous” population with long bones whose measurements indicated a Negroid ancestry; however, the scapula and sacrum are identical to Caucasians (Warren 1897:191).

Totter and Gleser published their method of estimating the stature from long bones in American whites and Blacks in 1952, and then a re-evaluation of the method was published in 1958 where miscalculated height measurements of two females were corrected. This formula for American Blacks was used to estimate the stature of ancient Egyptian human remains for many decades (Raxter *et al* 2008:147). This was probably based on some earlier examinations of the skeletons from ancient Egyptian historical sites.

In 1983 Robins and Shute carried out a study of the stature of 18th and 19th Dynasty kings. X-ray images were used to produce measurements of the long bones during that study (Robins & Shute 1983:455). The stature was estimated based on Totter and Gleser 1958 formula for Black Americans⁹¹ (Robins & Shute 1983:455).

More recently, a study to estimate stature was carried out on 36 adult male and 37 adult female dry ancient Egyptian skeletons from different historical periods (Raxter *et al* 2008:148). A new stature estimation formula specifically for ancient Egyptian bones, with standard errors of 1.9-4.2 cm, was devised (Raxter *et al* 2008:147). The new formula (Table 56.2) produced measurements more accurate than the Black American formula of Totter and Gleser (1952, 1958, and 1977). As this formula had been developed specifically for the

⁹¹ Robins (1983) studied the X-ray images and photos of skeletons dating to the Middle Kingdom and reviews the work of Warren on the bones from Naqada. The Negroid formula (from Totter and Gleser 1958) was used for stature estimation.

ancient Egyptian population, it was used during this study to estimate the stature of the adults in our group of mummies. Stature was calculated using the measurement of one or two long bones. The measurements were taken direct from the scout projection radiographs using the measuring tool in the viewing software. The total length of the femur was measured from the superior margin of femoral head to the inferior margin of femoral condyle. For the total length of the tibia, it was measured from the tibial plateau to distal tibial mid joint margin.

Table 6.2:Stature equations based on the length of long bones from an Ancient Egyptian population. (dimensions in cm)

(from Raxter *et al* 2008:150)

Gender	Element	Formula	Standard Errors of Estimates
Male	Femur	$2.257 (\text{Femur}) + 63.93$	± 3.218
Male	Tibia	$2.554 (\text{Tibia}) + 69.21$	± 3.002
Female	Femur	$2.340 (\text{Femur}) + 56.99$	± 2.51
Female	Tibia	$2.699 (\text{Tibia}) + 64.08$	± 1.921

6.5.4 Ancestry Determination:

It is important to determine the ethnic affinities or the ancestry of the individuals before stature can be estimated (Bass 1995:26). The skull, more precisely the facial features, provides accurate evidence (between 77% and 95% accuracy) which can be used to indicate the ancestors of adults⁹² (Wilkinson 1995:Per.Com, Bass 1995:86). Determination of the ethnic affinities from a skull of a sub-adult is much more problematic and almost impossible from Juvenile remains (Wilkinson 2005:Per.Com.). The main ancestry groups studied are Caucasoid, Negroid, Mongoloid and Australoids (Wilkinson 2005:Per.Com.). Morphologic variations were recorded for each racial affiliation (Table 6.3) (Fig:6.15) (Bass 1995:86). The ancestry of each individual in our group was assessed according to the morphological features from the X-ray and CT images of each mummy.

⁹² Other parts of the body were investigated as race indicators such as the anterior femoral curvature (Stewart 1962:49-62) but the results were disputed in later studies (Bass 1995:86).

Table 6.3:The main morphological Aspects of the three major ancestry groups (Table compiled from Wilkinson 2005:Per. Com. and Bass 1995:88-93):

Morphological Aspects	Caucasoid	Negroid	Mongoloid
Shape of the skull	Long to rounded	Long	Round
Nasal Aperture	Narrow	Wide, guttering in inferior piriform	Medium
Supra-orbital ridges	Moderate	Undulating	Less protrosive
Orbit	Angular, square outline		Shallow
Supra-orbital margins	Blunt	Sharp	rounded
Lateral orbital margins	Sharp		rounded
Glabella	Depressed- protrusive	rounded	Protrusive
Front nasal junction	Beetling	Plain	
Cheek bones	Sharp, less prominent, retreating	More prominent	Large, massive, very prominent zygomatic bones
Frontal aspect	Prominent		Flat
Mastoid process	Large		
Cranial sutures	Tortuous		simple
Nasal spine (or bridge)	Prominent, high, narrow	lower	Lower, short
Canine fossae	Deep		Weak- Absent
Prognathism	Mild or non	Strong, alveolar	Moderate
Lower mandibular boarder	Undulating	Very Broad	
Nasal root	Steepled, depressed	Low, rounded	Broad, flat tended
Inter-orbital distance	Narrow	Wide	
Forehead	Steeper	Full, rounded, upright and bulbous	Upright and bulbous
Sagital plateau	Absent		
Profile	Orthognathic, convex		Straight
Chin	Prominent		
Occipital curve	Variable	Full, rounded	
Shape of the head	Dolichocephalic	dolichocephalic	brachycephalic
Upper face	Protrusive	Less protrusive	Flat, straight
Lower face	Retrusive		Flat, straight
Palate	Long and narrow		Moderately wide- short
Eyes	Deep-set		Less deep-set
Nose		Wider, flatter and less protrusive	
Sagital contour		Flat	arched
Frontal sinus	Large	Less expanded	
Brow ridge			Absent
Front teeth			Shovel- shaped
Nasal profile			Straight
Face	Long narrow		Square, broad , flat

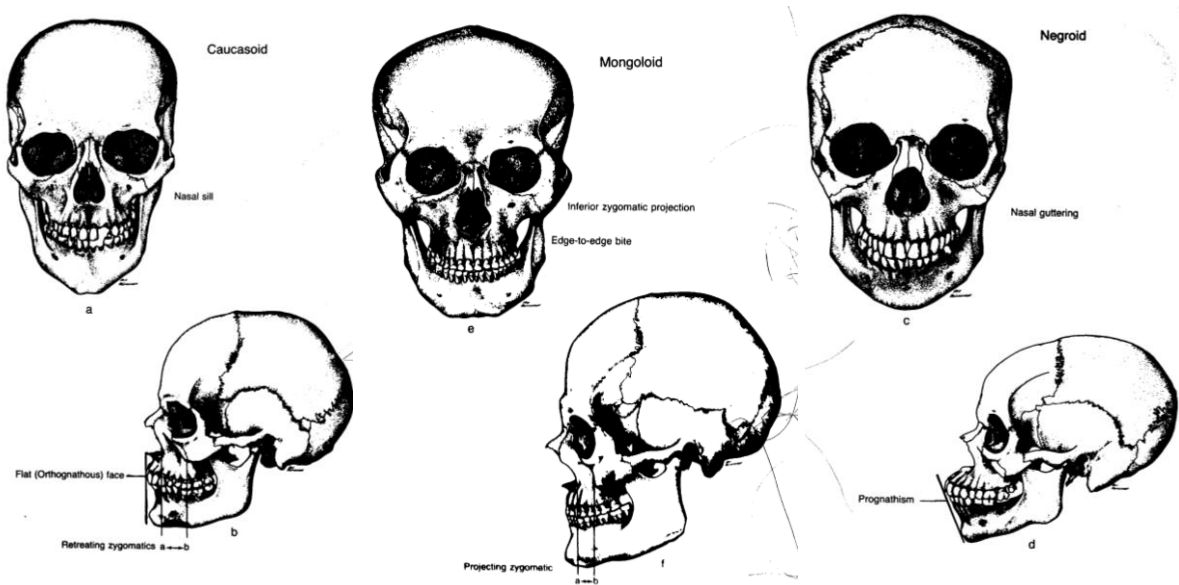


Fig:6.15 Cranial distinctive features of different ancestry groups.

(from Bass 1995:89-91)

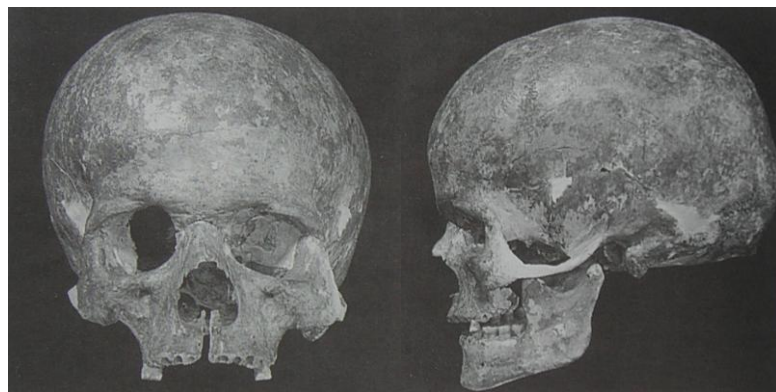


Fig:6.16 The skull exhibiting characters of Hydrocephalus diagnosed by Derry in 1913.

(From Nunn 2003:80)

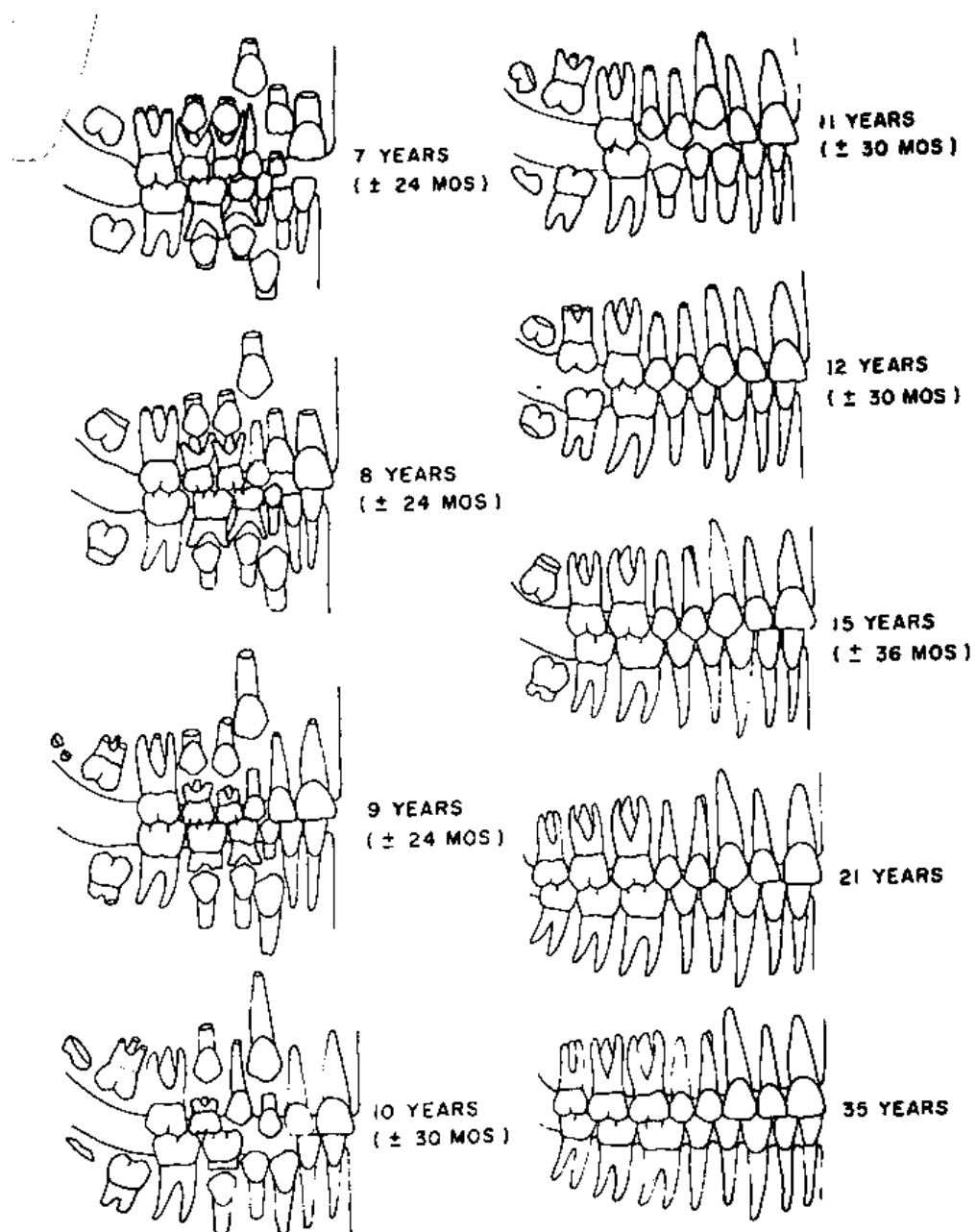


Fig:6.12 The formation and eruption of teeth from childhood through adulthood from Native American population.
(from Bass 1995:304)

6.6 Dental Examination⁹³:

One of the earliest studies of the ancient Egyptian teeth was published by Mummery (1870:17) who reported the examination of 36 mummified skulls. Mummery attempted to estimate the age at death based on the attrition levels of the teeth and described the shape of the crowns as pointed due to attrition (Mummery 1870:6). A number of dental diseases have been observed during different studies of ancient Egyptian remains; these include caries, ante-mortem tooth loss, attrition, fractured teeth and abscesses (Leek 1979:75).

6.6.1 Dental Caries:

Caries have not been commonly reported from ancient Egyptian remains especially during the earlier historic periods⁹⁴ (Leek 1979:75). A few cases were reported from the Middle Kingdom; however, most examples appear to be present later, during the Ptolemaic era (Leek 1979:75).

Caries can appear on the occlusal surface of the tooth, or on the neck of the tooth, on any of its four sides (Brothwell 1981:153). Molars are more susceptible to caries than incisors (Brothwell 1981:153).

6.6.2 Dental Attrition:

Attrition, especially of the cusps, is the most common and most recorded dental condition observed in ancient Egyptian remains (Leek 1979:75). However, this does not indicate any diet deficiency but it points to a coarse diet which has been mixed with sand, especially in the bread⁹⁵, causing abrasion and subsequent severe wear of the teeth (Leek 1979:75). The body would usually start producing secondary dentition to protect the tooth and replace the original dentine but in most cases the wear process proceeds much faster and bacteria attack the root canal, resulting in total destruction of the pulp and abscess formation (Leek 1979:75). There

⁹³ I am grateful to Dr. Daniel Antoine, Assistant Keeper, Physical Anthropology, Department of Ancient Egypt and Sudan, the British Museum, for his advice regarding the dental examination of the mummies.

⁹⁴ On the other hand, Brothwell (1981:151) mentions that caries started to appear and were associated with the *Homo sapiens*.

⁹⁵ The grinding techniques used for making flour are well recorded and examination of bread samples proved the high percentage of sand (Leek 1979:75).

is a substantial amount of pain involved once the enamel and dentine are worn through, leaving the pulp cavity exposed (Leek 1979:75).

Leek (1979:75) studied the patterns of wear and classified the degree of wear in four categories: class I shows attrition of the enamel and class IV represents severe wear of the tooth, resulting in losing most or all the body of the tooth and leaving only the root in place (Fig:6.13). The degree of wear can be used for age estimation (Fig:6.14) (see above) (Brothwell 1981:71).

6.6.3 Dental Hypoplasia:

In 2008 a study was carried out by Ritzman *et al* to compare all the published methods of estimating the age of formation of the hypoplasia lines that appear on the enamel. These lines provide evidence of periods of arrested growth and can be compared to Harris lines on the long bones (See below).

Dental abscesses of the tip of the roots were recorded during the radiological examination of the Egyptian mummies in Leiden (Taconis & Maat 2005:62), reporting that the radiographs showed a substantial number of this type of abscess (Taconis & Maat 2005:62). The different dental diseases and abnormalities were studied from the X-ray and CT images of the selected group of mummies. A separate dental protocol was used for the examination of the teeth⁹⁶.

⁹⁶ The protocol was adapted from Buikstra and Ubelaker (1994) *Standards for Data Collection from Human Skeletal Remains: Proceedings of a Seminar at the Field Museum of Natural History* (Arkansas Archeological Report Research Series), the Arizona State Museum Skeletal forms and guidelines and from Aufderheide (2003:358-359). Changes had to be made to the above mentioned protocols as they were devised for the examination of dry bone while the current study was based on examining the radiographs.

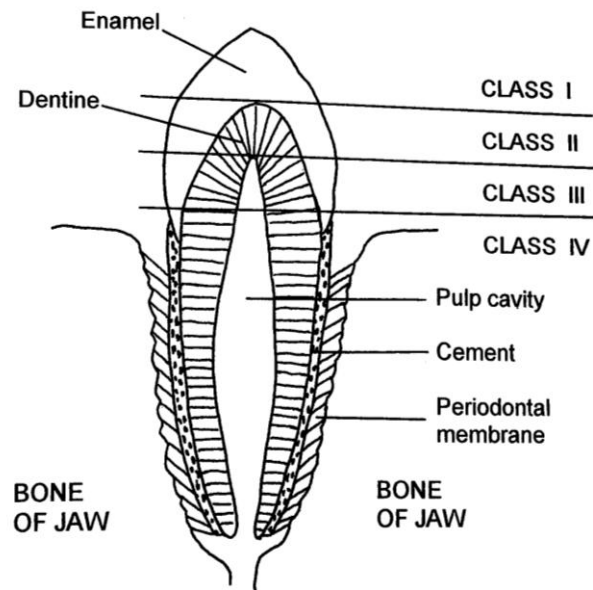


Fig:6.13 Leek's (1979:75) classification of attrition into 4 classes depending on its severity.

(from Nunn 2003:203)

Age Period (years)	About 17-25			25-35			35-45			About 45 +		
Molar number	M1	M2	M5	M1	M2	M5	M1	M2	M5	M1	M2	M5
Wear pattern			Dentine not exposed. There may be slight enamel polishing							Any greater degree of wear than in the previous columns		
OR												
OR										NB. Very unequal wear sometimes occurs in the later stages		

(1)	(2)	(2+)	(3)	(3+)	(4)	(4+)	(5)	(5+)	(5++)	(6)	(7)
No wear	Enamel only									Down to the neck	Roots only

Numerical classification of molar wear
(N.B. Some patterns are more common than others, and there are minor differences between upper and lower dentitions.)

Fig:6.14 Classification of age of adult skeletons based on wear of the molars.

(from Brothwell 1981 :72).

6.7 Paleopathology:

Paleopathology or the study of disease and anomalies in ancient human remains has been a well known field of research but has recently developed rapidly due to advances in techniques of examination such as CT scanning.

In 1875, Flower adapted a medical approach towards the examination of ancient Egyptian mummies when he reported two healed fractures, one in the forearm and another in a rib and inflammation of two lower lumbar vertebrae, which indicated a possible case of Ankylosis (Flower 1875:253). In 1927, Arnold Sach of Heidelberg University reported the examination of over 30.000 Egyptian mummies, focusing on detecting any signs of disease or trauma⁹⁷ (Anonymous 1927:71). He mentioned his observations of bladder stones and splints still attached to the limbs of mummies (Anonymous 1927:71). He also included his observations on the teeth of 500 mummies from Giza and concluded that the mummies of higher status had suffered greatly from tooth decay, caries and tartar (Anonymous 1927:72).

Evidence of surgical amputation was reported from a 9th Dynasty remains which suggested that healing took place following the operation (Roberts & Manchester 1995:90).

A wide range of disease and abnormalities has been reported in ancient Egyptian mummies. While dental disease, healed fractures and osteoarthritis are most often observed, syphilis was never reported in any remains older than 1500 AD (Roberts & Manchester 1994:158, Judd 2002:42).

6.7.1 Congenital Disease:

Evidence of congenital disease occurs, such as cleft palate in a female skull dating to the 25th Dynasty (Smith & Dawson 1924:157, Roberts & Manchester 1994:40), club foot as in the famous case of King Siptah⁹⁸ (Smith & Dawson 1924:157) and hydrocephalus from a skeleton discovered by Petrie in a Roman cemetery near Helwan (Fig:6.16) (Derry 1913:436).

⁹⁷ The large number of mummies examined might indicate that dry bones were also included in that study.

⁹⁸ In 1993, Forbes suggested that the king may have suffered from poliomyelitis (Nunn 2003:79).

Dwarfism, another congenital disorder caused by Achondroplasia, a gene mutation that affects the ossification of most of the skeleton, was frequently represented by ancient artists and has been reported from archaeological sites⁹⁹ (Roberts & Manchester 1995:33). Scoliosis¹⁰⁰ and Hyperkyphosis¹⁰¹ were recorded in the radiological examination of the collection of Egyptian mummies in Leiden (Taconis & Maat 2005:62).

6.7.2 Infections Disease:

The first leprosy case was reported by Smith and Dawson (1924:160) in a mummy dating to the early Christian Period (around 500 AD) (Fig:6.17). Another four cases of leprosy were later reported by Dzierzykay-Rogalski (1980:71-74) from the Dakhleh Oasis.

Arterial degeneration has been detected from microscopical examination of mummified tissue (Roberts & Manchester 1995:99). Microscopic examination of tissue samples was used to diagnose soft tissue infection in ancient Egyptian mummies (Roberts & Manchester 1995:133).

6.7.3 Joint disease such as gout occurred; a severe case was reported by Smith and Dawson (1924:157) from a preserved body discovered in a Christian cemetery¹⁰².

6.7.4 Metabolic diseases, including osteopenia¹⁰³ and osteoporosis¹⁰⁴ were also reported from six mummies in the collection of Egyptian mummies in Leiden (Taconis & Maat 2005:62). Rose and Zabacki (2007:9) examined the human remains excavated from the Amarna cemetery and found a high percentage of cribra orbitalia in 80% of the children and 19% of the adults, indicating iron and folic acid deficiency in the diet.

6.7.5 Neoplastic disease: Malignant cancer is rarely reported from ancient populations (David & Zimmerman 2010:728, Roberts & Manchester 1994:189) and only a handful of cases were confirmed (Wells 1963b:264). Life expectancy was mentioned by researchers as a

⁹⁹ For further information on dwarfism in ancient Egypt, Dawson 1938:185-189, Nunn 2003; 78-79, Dasen 1988:253-276,

¹⁰⁰ Curvature of the spine (Taconis & Maat 2005:62).

¹⁰¹ Concave thoracic spine, similar to Scoliosis, only affects the thoracic vertebrae (Taconis & Maat 2005:62)

¹⁰² The remains were sent to the Royal College of Surgeons in London (Smith & Dawson 1924:158) but were later moved to the Natural History Museum, London (Nunn 2003:80).

¹⁰³ “Loss of bone mineral” (Taconis & Maat 2005:62).

¹⁰⁴ Loss of organic bone matrix and minerals which was detected through the observation of the trabecular bone tissue in the shafts of long bones and the cortex (Taconis & Maat 2005:62).

possible cause for the rarity of confirmed cancer cases, while others suggested that deterioration and mummification techniques alter any evidence of the disease in the soft tissue (Zimmerman 1977:1358). This was proven to be inaccurate as cancer cells were reported from dehydrated mummified tissue (Zimmerman 1977:1359).

In 1909 Derry described a case of carcinoma of the nasopharyngeal region from Nubian remains dating back to the 4th - 6th Century AD. Wells (1963b:261-265) reported that examination of a skull with a large number of holes in the Duckworth collection, Cambridge, revealed that the individual suffered a malignant tumour¹⁰⁵.



Fig:6.17 The affect of leprosy on hands and feet- 6th Century AD-Nubia.
(from Smith & Dawson 1924:153)

¹⁰⁵ For further information about cancer cases, see Strouhal 1978:290-302, Brothwell 1981:143, Spingelman & Beutley 1997:107-114, Capasso 2005:2-13.

6.7.6 Harris lines:

Plain radiographic digital images of the lower extremities were used to identify Harris lines (disturbed or arrested growth transverse lines) in the specimens. Harris lines are transverse lines of higher density or radio-opaque lines in the metaphyses that can be seen in the radiographs of long bones (usually tibia, femur¹⁰⁶ and radius) (Fig:6.18) (Roberts & Manchester 1995:175). Harris lines can be also detected in other parts of the skeleton: a Polaroid X-ray image of a mummified child showed Harris lines in the illium (Conlogue *et al* 2004:257). Similar lines seen across the enamel of the teeth are called enamel hypoplasia¹⁰⁷ (see above) (Roberts & Manchester 1995:58).

The transverse lines on the long bones were reported by Harris in 1931 when he radiologically examined a large number of skeletons of still born children¹⁰⁸. He associated the lines with periods of malnutrition of the foetus as the result of an illness that affects the pregnant mother (Harris 1931:622).

The transverse lines would be visible only in children or sub-adult skeletons as the lines disappear in most adults due to constant remodelling of the bone throughout life (Roberts & Manchester 1995:176). This would explain why the radiographs that show Harris lines usually belong to children or sub-adults, usually between the age of 6 and 12 (Pointek *et al* 2001:33). When an adult skeleton does not show evidence of Harris lines, this could indicate either that the lines existed during childhood and then disappeared during adulthood due to bone remodelling, or that the lines did not form during childhood.

¹⁰⁶ As the femur and the tibia are fast growing bones in length, they tend to display visible distance between the transverse lines which allows more accurate examination (Hunt & Hatch 1981:466). The femur and tibia are also strong bones that are likely to be the best preserved from an archaeological context (Hunt & Hatch 1981:466).

¹⁰⁷ Researchers have studied the formation of Harris lines and dental hypoplasia in the skeletal remains of different populations to establish if they were caused by the same type of stress but the results were inconclusive (Roberts & Manchester 1995:60). For example a study on prehistoric Native Americans proved that Harris lines and dental hypoplasia are not correlated (McHenry & Schulz 1976:509), while another study on the ancient Nubian population found strong correlation between two stress indicators: dental hypoplasia and pitting in the orbital roofs known as cribra orbitalia which indicates iron deficiency (Roberts & Manchester 1995:60, 167). Harris lines were found to have no relation to the femoral length, as reported by Mays (1985:207). This also highlights the difficulty in establishing a reason for the formation of the lines which were referred to, along with dental hypoplasia, as “nonspecific indicators” by Buikstra and Cook (1980:436) who suggested that, as the lines do not affect the growth of the long bones as proven by Mays (1985:207), they should not be referred to as “arrested growth lines”.

¹⁰⁸ The lines were first reported in 1874 by Wegner who observed the lines while examining cross sections of bones of rabbits and chickens (Wells 1963a:406).



Fig:6.18 Radiograph of a tibia showing lines of arrested growth, Harris lines, on distal and proximal ends of the long bone.
(from Roberts & Manchester 1995:176).

The lines represent bone lattice or plates formation during a period of time when the bone did not grow in length (Roberts & Manchester 1995:176, Hunt & Hatch 1981:466). This would generally indicate periods of ill health or malnutrition¹⁰⁹ that did not continue for a long time but were followed by a period of health (Roberts & Manchester 1995:176). Poor diet and metabolic stress has been suggested by Hummert and Van Gerven (1985:305) as a reason for the formation of the arrested growth lines.

Harris lines do not appear on bones of individuals who suffered long term malnutrition or did not survive a long term illness (Roberts & Manchester 1995:176). The lines were called “temporary” arrested growth lines by Anderson *et al* (1963:9); however, Wells (1963a:406) described them as “scare lines” and mentioned that they are evidence of stress, and that they remain permanently in the bones. The lines also indicate that recovery took place, according to Roberts and Manchester (1995:176). For this reason, the lines of arrested growth cannot be considered as associated with death. They only indicate that the individual suffered from periods of stress during childhood¹¹⁰.

On the other hand, Strouhal and Vyhnánek (1974:128) disagree with this idea and suggest that the lines were formed during childhood because of disease and have no relation to poor diet. These lines are common in Egyptian mummies and have been detected in a large number of radiographic investigations (Gray 1973:52; Strouhal & Vyhnánek 1974:128). Other physical anthropologists disagree with the previously mentioned theories regarding the reason behind the formation of Harris lines. It has been suggested that the lines do not indicate ill health or poor diet but simply the formation of new bone cells while the individual is growing (Antoine 2010:Per. Com). Roberts and Manchester (1995:201) concluded that the reasons behind the stress which may cause formation of the lines are still unknown¹¹¹.

Physical anthropological standards have been developed to evaluate these lines and estimate the age of the individual when each one was formed (Hunt & Hatch 1981:461, Maat 1984:291). Hunt and Hatch (1981:466-467) used a method of estimating the age by

¹⁰⁹Studies in formation of Harris lines in animals provided evidence that associates the development of the lines with deficiency in protein and vitamin A (Gronkiewicz *et al* 2001:46).

¹¹⁰ For more information about Harris lines in archaeological context, see Pointek *et al* 2001:33-43, for evidence of Harris lines correlating with seasonal periods of poor diet, see Lobdell 1984:109-116) and on formation and persistence of the lines, see Hummert and Van Gerven (1985:297-306).

¹¹¹ Emotional stress was also mentioned as a possible reason for the formation of Harris lines and dental hypoplasia (Roberts & Manchester 1995:164).

measuring the distance between the centre of ossification or the origin of the long bone and each transverse line¹¹². This method is based on the growth rates at both ends of each long bone. These rates were measured in 1963 by Anderson *et al* who conducted a study of more than 200 sub-adults with Harris lines.

The CT images were examined in order to identify any evidence of abnormalities and pathological conditions that the mummies have suffered during life. A study of the X-ray radiographs and the CT images was carried out to detect any possible causes of death in any of the mummies.

6.8 Mummification Techniques:

The CT images together with the plain radiographs were used to study the position of the body and the extremities of each mummy. The size, orientation and location of the evisceration incision were also examined from the CT images which can clearly show if the incision was stitched, left open, blocked with resin or covered with a metal plaque. In cases where there was no evidence of an evisceration incision, further examination was carried out to identify any other methods of evisceration methods that may have been used.

The CT scans were used to determine which internal organs were removed and where they were repositioned inside the body, to establish if any treatment of the genitals had been carried out and if any evidence survived of post mortem restoration of the body, carried out by the embalmers. The route used by the embalmers to extract the brain can be shown on CT images as damage to the ethmoid passage which would indicate brain removal through the nose. If the brain has been removed but the nasal route is intact, this indicates that the embalmers extracted the brain through the foramen magnum; CT images could provide evidence for this procedure. Evidence of other mummification procedures, such as incisions for subcutaneous packaging or the inclusion of false eyes, was sought in X-ray and CT images.

¹¹² Hunt and Hatch (1981:467) produced four equations of formulas to estimate the age when each of the Harris lines was formed based on measurement of the distance between the origin or the centre of ossification and each line in the distal and proximal end of the femur and the tibia. They used the same technique to estimate the age at death from the length of long bones (Hunt & Hatch 1981:466). For methods of estimating the age of formation of dental hypoplasia lines, see Ritzman *et al* 2008:348-361.

6.9 Wrappings and distribution of resin:

This study included a brief examination of the linen wrappings of each mummy. As noted in previous studies (Taconis & Maat 2005:55), high humidity levels, deterioration and aging have affected the linen wrappings and would prevent any accurate or reliable counting of the layers. Instead, measurements of the thickness of the wrappings at different parts of the body proved to be a more precise and practical method for studying the bandages (Taconis & Maat 2005:55). These measurements were obtained from the CT images which also provided evidence of any extra substantial bundles or sheets of linen added by the embalmers during mummification (Taconis & Maat 2005:55). The technique and sequence of wrapping the body was investigated by means of the CT images. In a previous study of mummy wrappings, small grains of sand were detected in different places throughout the linen bandages (Vyhnánek & Strouhal 1976:120). This indicates that the wrapping process probably took place out-of-doors; the bandages were still wet and saturated with resin when the embalmer wrapped the body in a location exposed to wind-blown sand (Vyhnánek & Strouhal 1976:120). This possibility was also considered during the examination of the wrappings of the mummies in this study.

Wrappings soaked with resin have a higher density than plain (pure clean) ones. Based on this fact, the depth of these resinous wrappings and their thickness provides some evidence of the amount and distribution of the molten resin used by the embalmers.

6.10- Facial Reconstruction:

Although the idea of preserving the face of the deceased existed during ancient times, scientific techniques of facial reconstruction have only rapidly developed during the last few decades (Prag & Neave 1999:18). Recently, the technique has gained publicity with high profile facial reconstructions such as that of Tutankhamun, and also through the television series “History Cold Case” which features facial reconstruction as an important element of investigating archaeological human remains.

The first modern facial reconstruction of an Egyptian mummy took place in the University of Manchester as part of the multidisciplinary mummy team led by Professor Rosalie David (Prag & Neave 1999:41). A plaster replica of the skull of Nekhtankh, who lived during the

12th Dynasty and is one of the famous Two Brothers whose tomb was discovered by Petrie in 1907, was used by Neave to build a clay model of his face (Prag & Neave 1999:43). The reconstruction of the face of the second brother, Khnumnakht followed shortly afterwards and a comparison of the features of the two brothers and their statues was made. Drawings based on the skull were also produced. As the Manchester mummy team went on to study the female mummy 1770, a facial reconstruction based on a cast of her fragmented skull was also produced (Prag & Neave 1999:50).

The technique progressed further when the mummy of Natsefamun was examined by the team. CT images were used to produce a styrene foam model of the skull using a computerised milling machine (Prag & Neave 1999:51). This technique allowed the facial reconstruction to be undertaken of mummies where the soft tissues were still preserved and not just the underlying skeletal material. The technique has also been used with wrapped mummies.

The skull provides vital information for the reconstruction, with regard to the gender, ethnic background, age at death, teeth and any abnormalities or anti mortem facial traumas that have left their marks on the bones (Manley *et al* 2002:158). This information would establish the soft tissue thickness assigned to different parts of the face, based on premeasured standards for different age, gender and ethnic background (Manley *et al* 2002:158). The skull also gives clues about the shape of the nose and earlobes. However, some information cannot be retrieved, such as the exact shape of the hair line and the exact colour of the skin and the eyes.

A multidisciplinary team led by the Japanese Egyptologist Yoshimora was the first to reconstruct the face of an 18th Dynasty Egyptian mummy using the information obtained from 49 CT images of the head (Cesarani *et al* 2004:758).

A facial reconstruction of an unidentified female who lived during the 17th Dynasty, and is thought to be a queen from Nubia, was also carried out (Manley *et al* 2002:155). As the skull did not provide sufficient evidence regarding her ancestral origin, three drawings of the same individual with different skin tones were produced (Fig:6.20) (Manley *et al* 2002:155). More recently, computer software called “Amira” was developed to produce computerised 3D facial reconstructions based on the data from the CT image. This was the technique used

during the current study to build up the facial features of the mummy of Tjntmutengebtu (EA 22939). The computer produced a 3D image of the skull based on the CT slice images. Some manipulation had to be performed to modify the position of the mandible as the mouth appeared to be slightly open.

Soft tissue depth measurements for North Americans and Europeans were used as the standards for the facial reconstruction of Egyptian mummies until a study of 204 Egyptian individuals between the age of 20 and 35 was published by El-Mehallawi and Soliman (2001). In this study, ultrasonic probing was used to obtain the soft tissue depth measurement in 17 different locations from each individual (El-Mehallawi & Soliman 2001:99). The results of this study show that Egyptians had unique facial measurements when compared to previous studies on other populations. Therefore, these Egyptian facial tissue depth measurements were used as reference points in the facial reconstruction of the mummy of Tjntmutengebtu (EA 22393). This was carried out by attaching virtual pegs to the surface of the 3D image of the skull according to the measurements of El-Mehallawi and Soliman (2001:104). Muscles and skin layers were then applied to the surface of the virtual skull to produce a 3D image of the mummy¹¹³. No colour was applied to the skin, eyes or hair of the reconstruction. The head was presented shaved and no hair was applied, since it was considered preferable to present a 3D reconstruction based on evidence from the skull rather than on speculation.

¹¹³ I am grateful to Tobias Houlton, Centre for Anatomy and Human Identification, Dundee University, for his time and effort during the facial reconstruction of the mummy of Tjntmutengebtu.



Fig:6.19 Three different skin tones applied to the same facial reconstruction as the ethnical background was undetermined (from Manley *et al* 2002:157).

7- Chapter Six: Results and Discussion:

7.1 Introduction:

Visual examination of the mummies was conducted and detailed digital images of each mummy were obtained. The conventional X-rays and the CT images were studied in detail and the findings discussed with the supervisor. Measurements, aspects of mummification and any abnormalities were studied from the X-ray radiographs, the CT slice images and the reformatted reconstructions. The post- processing and analysis of the axial scans, reformats and 3D reconstructions were carried out on the reconstructed images using a PC workshop and a variety of computer software. Selected reformations were obtained, but when these were performed on the entire large number of sections this occasionally caused the system to crash. Virtual unwrappings and three dimensional rotations were obtained.

Three dimensional reconstructions were produced especially for visualising the amulets or any artefacts detected within the mummies. The images were used to record the various mummification techniques that were used for each part of the body as well as the degree of preservation of the mummy. Axial CT, reformatted images, 3D reconstruction and X-ray images were used to evaluate the condition of the teeth. Patterns of wear (attrition, abrasion or erosion) and evidence of dental disease such as abscesses, dental caries or cysts were reported.

The collection of mummies dates back to the same period and belongs to individuals who lived in Thebes. Except for *Djedameniufankh* (EA 29577), it has been confirmed that all the cartonnage cases belong to priests and priestesses; this is based on the inscriptions on the coffin or the cartonnage cases. There are only a few cases where it is not confirmed that the mummy belongs to the coffin or cartonnage case (for example the mummy in the coffin of Hor (EA 6659)), although examples of mummies being placed in different coffins following their discovery are not uncommon¹¹⁴. The mummy inside the coffin of Hor is likely to belong to the coffin as it shows evidence of Third Intermediate Period mummification techniques

¹¹⁴ Other cases of ancient swapping have also been reported, for example Kanawati *et al* 1993.

and the style of the outer wrapping corresponds with the style of the decoration on the coffin which follows the style of the 22nd Dynasty.

In general, it seems that the group belong to individuals who lived during the same period, in the same area and most of them worked in temples as priests. For this reason the collection was analysed as a group, as similar patterns were observed, especially in respect to the mummification techniques. However, variations and, in a few cases, unusual and unique aspects, were also reported.

7.2 - Physical Anthropological Data:

7.2.1 - Sex determination:

Results:

The group consists of seven full mummies which were examined during this study. The sex determination was generally a straightforward process. The study showed that there are four males (EA 6659- 6681-6682-29577) and three females (EA 20744- 22939- 25258). The sex determination of two of the males was confirmed by the presence of a penis (EA 6659-EA 6682). Two of the females were confirmed by the observation of the soft tissue which showed two orifices (EA 20744- EA 25258).

Discussion:

Some female traits were observed in male mummies such as the pelvis of *Pef-tauemawy-khonsw* (EA 6681), which showed some female aspects and some male aspects were reported from female mummies such as the skull of *Tjentmutengebtiu* (EA 22939) which displays pronounced gonial flaring and strong nuchal lines, which are more masculine features (Fig: 7.1).



Fig 7.1: LP view of the 3D reconstruction of the skull of Tjentmutengebtui, EA 22939 showing the slight male traits of the pronounced gonial flaring and strong nuchal lines. The holes that appear at the top of the skull do not represent an abnormality. However, they represent missing information during transferring 2D images to 3D images of the skull which is known to be a software flaw.

Cultural comment:

All three female mummies in this collection had titles which associated them with the religious practice which highlights the role of women in temple rituals during this historical period. Robins (1993:142) mentioned that, as early as the Old Kingdom, women contributed to the temple ceremonies. Upper class women bore titles such as *Hemet ntr*, Priestess of Hathor, *wabet* and *Shemayet*. Female and male priests of the same rank were paid equally (Robins 1993:125). “Musician of Amun” was the title given to high class Theban women who served at the temple of Amun (Robins 1993:125). Women who bore this title were often depicted holding a sistrum which is a metal rattle that was used during temple rituals. They were also represented carrying a necklace with a counterpoise called *menatt*¹¹⁵.

7.2.2- Stature:

Results:

The stature was calculated from at least two of the long bones, the femur and the tibia. The standard deviation of the stature calculated from the femur was about 3.2cm and of the stature calculated from the tibia was about 1.9cm. The overall height was also measured from the AP and LP scout images, where possible¹¹⁶. These measurements were taken from the vertex to the soles of the feet and did not include the layer of wrapping. Another set of measurements were taken for the wrapped mummies and a different set for the total length of the cartonnage cases.

Discussion:

The total height measured from the long bones matches reasonably well with the total height measured from the scout images (Table 3). The calculated height was not greater than the measured length of the mummy except for the case of the mummy of Hor, EA 6659, where the difference was less than 1cm which would still be considered within the range of the standard deviation of the calculated stature.

¹¹⁵ For further information on the role of women in the temple, see Robins 1993.

¹¹⁶ In two cases it was not possible to measure the total height of the mummy from the scout projections; EA 25258, because of the disarticulation of the feet, and EA 29577, due to the disturbed state of the mummy as the head is disarticulated and placed outside the disturbed layers of wrappings.

Table 7.1: Summary of the Physical Anthropological results:

BM no.	Name	Date	Sex	Age	Stature
EA 6659	Hor	22 nd Dynasty	Male	35-45	162.34 cm \pm 3.218
EA 6681	Pef-tauemawy-khonsw	25 th Dynasty	Male	Young adult	158.24cm \pm 3.218
EA 6682	Padiamunet	25 th Dynasty	Male	30-40	167.2 cm \pm 3.218
EA 20744	Tjayasetimu	22 nd Dynasty	Female	About 12	Not assessed
EA 22939	Tjentmutengebtiu	22 nd Dynasty	Female	20-30	157cm \pm 1.921
EA 25258	Unknown	22 nd Dynasty	Female	40-50	152.9 cm \pm 2.517
EA 29577	Djedameniufankh	22 nd Dynasty	Male	15-22	168.54 cm \pm 3.218

Table 7.2: The relation between the calculated stature and the measured height:

BM no.	Calculates Stature	Measured height of mummy from vertex to soles of feet	Measured length of wrapped mummy
EA 6659	162.34 cm \pm 3.218	161.8cm	163.9cm
EA 6681	158.24cm \pm 3.218	161.2cm	164.4cm
EA 6682	167.2 cm \pm 3.218	168.5cm	174.5 cm (calculated)
EA 20744	Not assessed- child	125.6cm	129.6cm
EA 22939	157cm \pm 1.921	154.1cm	157.2cm
EA 25258	152.9 cm \pm 2.517	Disarticulated feet	156.7
EA 29577	168.54 cm \pm 3.218	Disarticulated head	Disturbed wrappings

7.2.3- Age determination:

Results:

For the adults in the group (all except EA 20744), the teeth were the main location for examination to establish the degree of molar attrition. The age at death was estimated to be between 20 and 50 for the adults. Two individuals, EA 6681 and EA 29577, were in their lower twenties, one in her mid twenties (EA 22393), one in their lower thirties (EA 6682), one in his higher thirties (EA 6659) and one in her higher forties (EA 25258). None of this group has an estimated age at death of over 50 years old.

As for Tjayasetimu (EA 20744), the dental age was estimated at between 7 and 8 years old¹¹⁷. However, the skeletal age, which is based on the fusion of the epiphyses, is between 10 and 13 years old. The lengths of the long bones were taken and the tables of the orthoroentgenographic measurements of female children (Bass 1995: 229) were used for age estimation. The maximum length of right femur is 34.15cm and the maximum length of left femur is 34.51cm. This would indicate an age of about 9 years old. The right tibia measures 28.26 cm which would indicate an age of between 9 and 10 years old (according to the same table mentioned above, tibia section) (Bass 1995: 249). When examining the pelvis for age estimation it appeared that the triradiate puboiliac and the triradiate ilioischial are ossified which would indicate an age of between 11 and 15 years old¹¹⁸. For all the above reasons the mean estimated age would be about 12 years old.

For the mummy of the priestess, EA 29577, the estimated age based on the development of the teeth is between 15-25 years old. The occipital lamboid sutures appear to have minimal closure and do not show a large degree of fusion which indicates a young adult. Most of the long bones are fully fused: for example, the humerus head (distal) which would fuse any time between the age of 15 and 22 years old. By examining the femur, it appeared that the age at death is about 20 years old. The overall estimated age at death is about 20 years old.

¹¹⁷ See the chart of teeth development from 6 months in uterus to 35 years in Scheuer & Black 2004: 177.

¹¹⁸ See Scheuer & Black 2004: 338 for the appearance and fusion times of the pelvic ossification centres.

Discussion:

Life expectancy for adults in Ancient Egypt:

As no full data is available, it would be an impossible task to estimate life expectancy in ancient Egypt (Nunn 2003: 22). Most of the available data from discovered burials point to an average of about 30 years old during the Predynastic Period and 36 years old during the Dynastic Period (Nunn 2003: 22). This represents life expectancy for adults and does not include children. This corresponds with the estimated age of this group of mummies. A study of more than 600 skeletal remains discovered in a number of sites in Upper Egypt concluded that only 67 lived over the age of 50 and 368 died under the age of 30 years old which indicates that 39% of that population lived to celebrate their 30th birthday (Puech *et al* 1983:618). A few individuals from ancient Egypt were known to reach a much older age (over 80 years old), for example, Ramesses II and Pepi II, in addition to a few non-royal individuals (Nunn 2003: 22). Simple illnesses would have claimed the life of many people who did not have access to modern medicine.

7.3- Cartonnage manufacturing techniques:

Results:

Six mummies from our collection are inside cartonnage cases. Only one mummy, EA 6659, is inside a wooden coffin. A study of the manufacturing techniques and the condition of the cartonnage cases was carried out during this study. The CT axial images and the 3D images and rotations proved to be extremely valuable. The CT axial images showed cross sections of the cases along the length of the mummy while the scout images proved useful in determining the relation between the mummy and the cartonnage case or the location of the mummy inside the case.

EA 6659: only the lower part of the coffin was included during the radiographic examination as the lid did not travel to Manchester. The coffin is 22cm longer than the wrapped mummy (the distance between the wrapped head and the internal side of the coffin); however most of the body fits tightly within the available space inside the coffin. The CT images showed details of each piece of wood and how the pieces were assembled together to construct the coffin. The images also showed areas of internal damage to the wood which will require some consolidation (Fig: 7.2). They also showed a foreign object within the base of the coffin which might be an ancient restoration to the coffin (Fig: 7.3). Although the 3D image shows

that the object has the same level as the surface of the coffin, it has a different density and a defined shape. It was not possible to confirm the identification as an ancient restoration since the mummy was not removed from the coffin during examination and there are no photographs of the inside of the coffin during the procedure of extracting the clay figure when the mummy had to be taken out of the coffin.

EA 6681 (Figures 7.4, 7.5, 7.6 & 7.7): The mummy fits tightly inside the cartonnage case with only a few centimetres difference between the height of the cartonnage and the wrapped mummy. The images show that the thickness of the cartonnage case reached its maximum in the face area. There is an additional layer of what could be plaster that supports the facial features from the inside (Fig: 7.6), although this may have been a layer of the core that was intentionally left in place for the same purpose. A diagonal impact on the cartonnage case can also be seen from the axial images of the head area (Fig: 7.6). The CT axial images also show damage to the bottom side of the cartonnage and loss of the outer plaster layer, especially the area under the head (Fig 7.4).

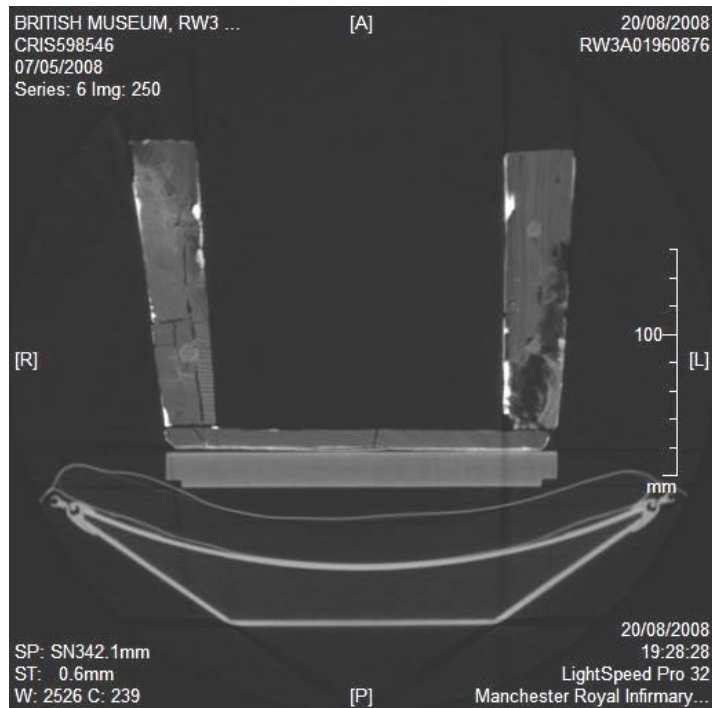


Fig: 7.2: EA 6659: CT cross sectional image of the coffin showing the internal damage to the wood that can not be seen during the visual examination.



Fig: 7.3: EA 6659: 3D image of the foreign object within the internal surface of the base of the coffin which may be an ancient restoration. The round object is probably a dowel that was used to fix the object in place. The material may be plaster.

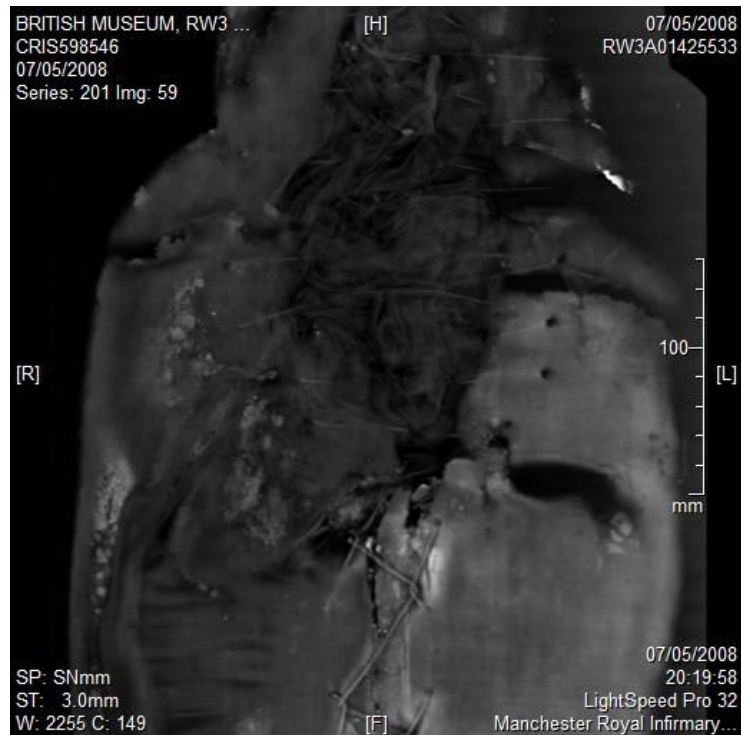


Fig: 7.4: EA 6681: Formatted image showing the back of the cartonnage case (head and chest area). The damage, perhaps caused by tomb robbers, is clear as the wrappings appear to be disturbed. The original laces appear at the bottom of the image while in a later restoration thinner lace was used to keep the sides of the case together.

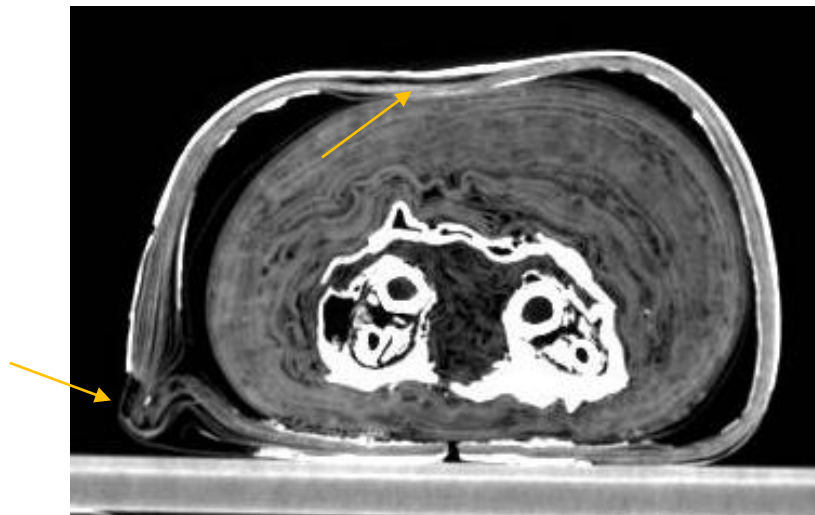


Fig: 7.5: EA 6681: Arrows point to the internal damage to the cartonnage case that would not be observed during the visual examination. At the top, the layers of linen have separated from the layer of plaster and are resting on the outer layer of the mummy wrappings. Bottom left, the layers of linen have separated from the damaged plaster layer. The shape of the linen layers is distorted.

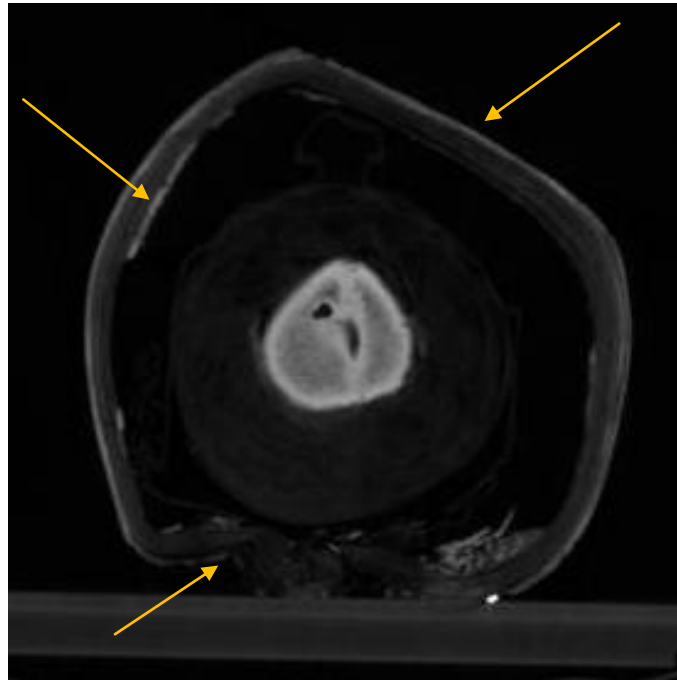


Fig: 7.6: EA 6681: The top right arrow points to the diagonal dent at the head of the cartonnage and the lower arrow points to the damaged area of the cartonnage case and loss of plaster at the head area. There are also remains of a dense layer on the internal wall of the cartonnage case (top left arrow). This could be remains of the core that was used during the manufacturing of the case.



Fig: 7.7: EA 6681: Top right arrow, the face area of the cartonnage case supported internally by a denser layer of what appears to be plaster or the core material used during the manufacturing of the cartonnage case. The arrows to the left and right sides point to bilateral damage of the cartonnage case as the gummed linen layers separated from each other and from the external layer of plaster.

EA 6682: The cartonnage case is about 176cm long and the mummy occupies all the space inside the cartonnage which had been extended at the foot area in ancient times to accommodate the full length of the mummy. Dawson and Gray (1968:14) mentioned in their report that the case was too large for the mummy that only reached the shoulder area and that the extension was not needed. It is clear from the X-rays and the CT scout images that the mummy fills all the available space inside the cartonnage case including the extension that houses the feet. The face area inside the cartonnage has been filled with a dense material as it appears in the radiographic and 3D images (Fig 7.8 & Fig 7.9).

EA 20744: The CT images provided valuable information regarding the manufacturing techniques of the cartonnage case. The modelled unique cartonnage case appears to be about 20 cm longer than the wrapped mummy inside it. The CT images also showed that the wooden face has been attached directly to the glued layers of linen before the layer of plaster was applied to the case (Fig 7.10 & Fig 7.11). The CT images show clearly a number of tree rings which confirms that the gilded face of the cartonnage is made of wood (attenuation = -480). The eyes of the wooden face were inlaid with high density, probably stone, eyes (attenuation = 1520). The extended lower right arm does not appear in the radiographs because it remained at the British Museum while the cartonnage and mummy were transported to Manchester. The images also show a number of internal cracks. This information would be important for conservation purposes. There is no evidence of any lacing at the back of the cartonnage case. It is clear from the images how the wood foot board was attached to the cartonnage by means of wooden dowels. The modelled feet on the cartonnage case were also made of wood as the tree rings are visible in the CT images.

EA 22939: The length of the cartonnage case is about 170cm while the height of the wrapped mummy is 157cm which leaves an empty cartonnage internal space of about 23cm. There is evidence of lacing still in place. The thickness of the cartonnage is about 1cm. The front of the cartonnage is less thick than the sides and the back. Remains of plaster or core material used during the manufacturing of the cartonnage case can still be seen behind the face area. The gilded face of the cartonnage has dense inlaid eyes (attenuation = 1613HU) (Fig 7.12). The small moulded nose of the cartonnage has an attenuation value of 628HU.

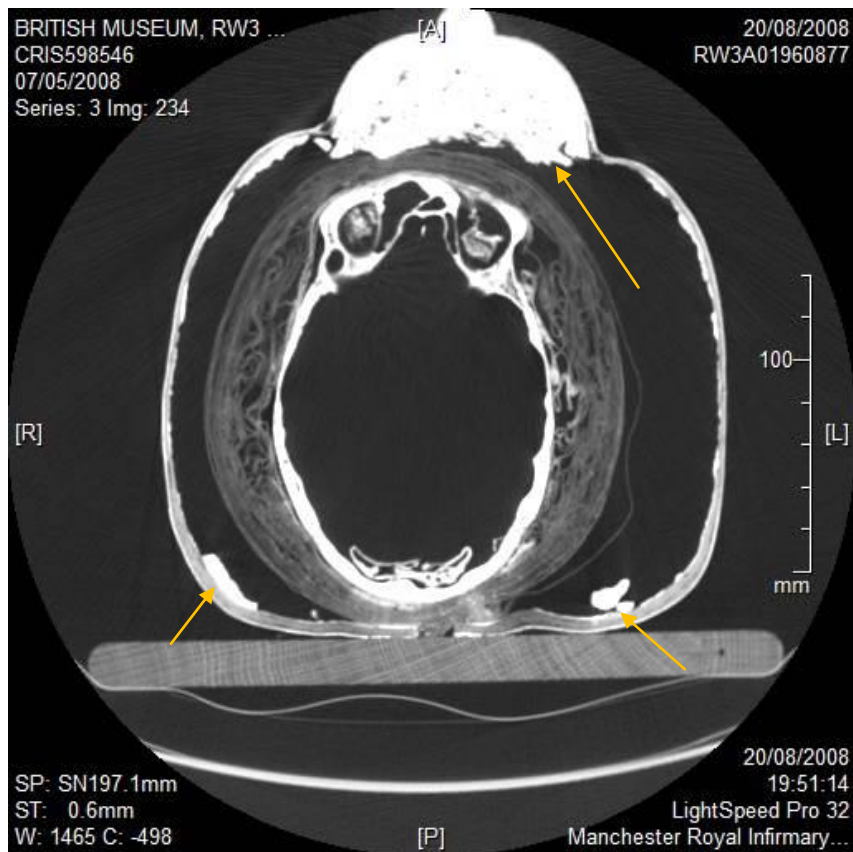


Fig 7.8: EA 6682: The dense material supporting the face area inside the cartonnage case. Few fragments of the same material have fallen and appear in the radiograph next to the back of the head.

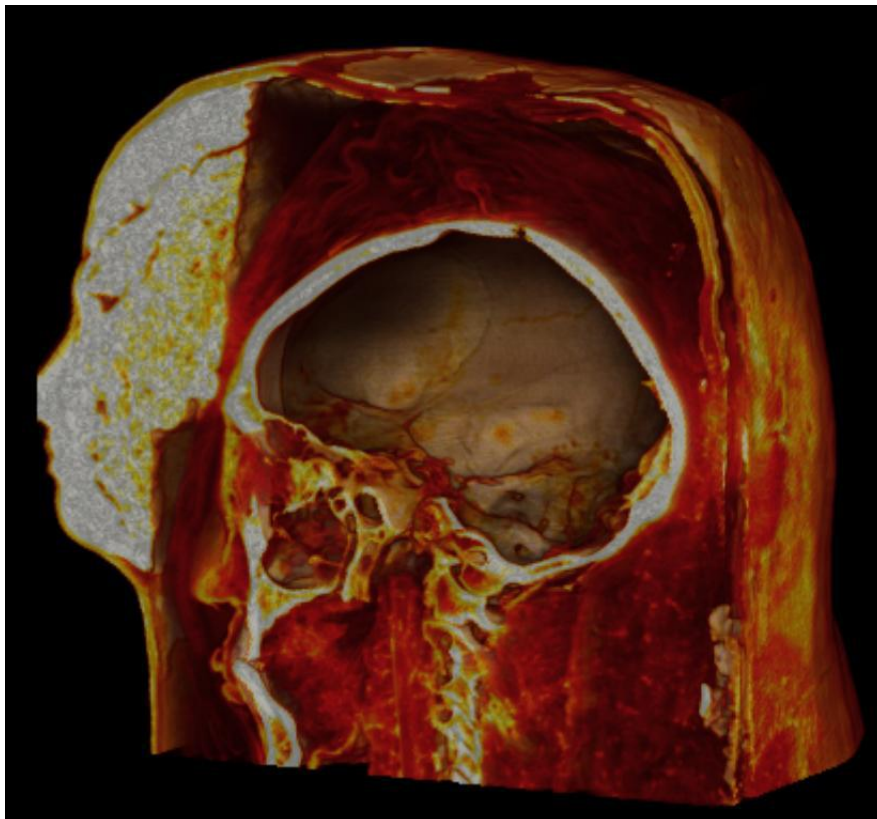


Fig 7.9: EA 6682: 3D image of the head area of the head area of the cartonnage showing the location of the wrapped head in relation with the cartonnage and the material used to pack the face area from inside the cartonnage case.

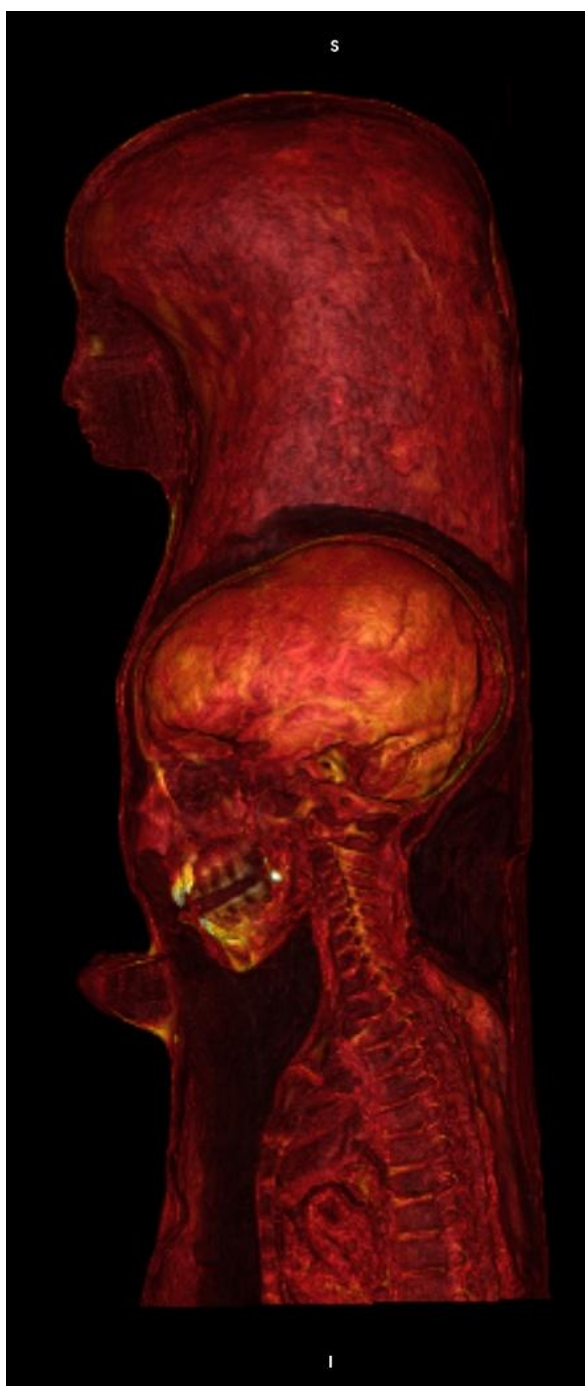


Fig 7.10 EA 20744: 3D image a longitudinal section showing the difference in height between the wrapped mummy and the cartonnage case. The wooden attached face is also visible in addition to the wooden left hand.

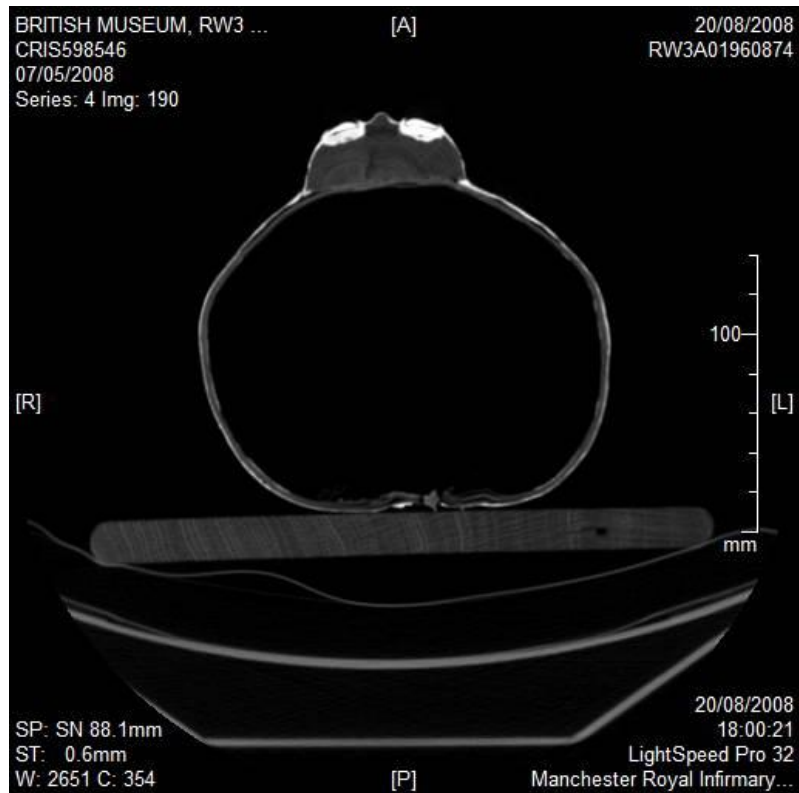


Fig 7.11: EA 20744: CT axial image showing the gilded face with inlaid eyes. The face was modelled in wood and placed directly over the layers of gummed linen, as no plaster was evident under the modelled face.

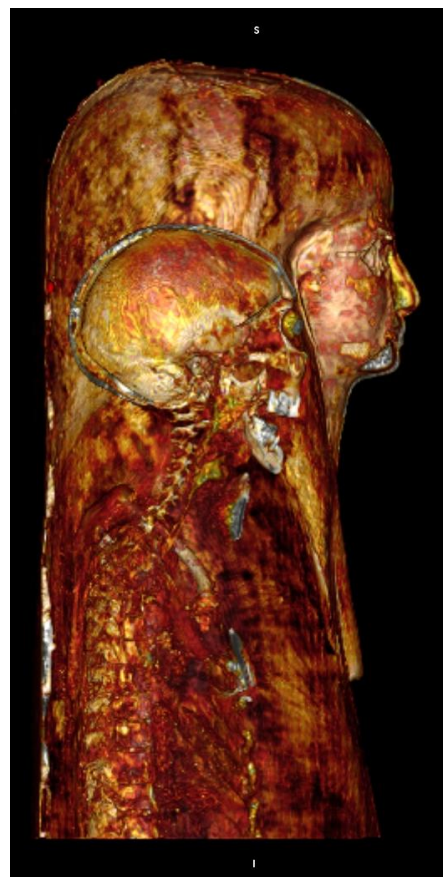


Fig 7.12: EA 22393: Longitudinal 3D view of the cartonnage and mummy showing their location and the inlaid eye of the cartonnage case.

EA 25258: The total length of the cartonnage case is 165cm while the total height of the wrapped mummy is 157cm. The empty space inside the cartonnage case is about 18cm. Remains of the core can be seen in various locations on the internal surface of the cartonnage case. The face has a much higher density than the rest of the cartonnage due to plaster-like material that had either been applied to support the face during the manufacturing of the cartonnage or is the remains of the core that was intentionally left for the same reason (Fig 7.13). The face that has been fashioned in the anterior part of the cartonnage has an attenuation of 665HU. The upper part of the mummy occupies the right side of the cartonnage. There is a gap about 5 cm wide at the back of the cartonnage between the two sides of the slit used to insert the mummy into the cartonnage (Fig 7.14).

EA 29577: The face of the cartonnage is made of wood. There is an oblique crack in the centre of the wooden face. Within the wood there are two high density oblong structures which have an attenuation of 1306 HU suggesting a metallic substance. The larger on the right of the midline measures 29mm in sagittal diameter and 11mm in coronal diameter (Fig 7.15). The smaller area measures 15mm in sagittal diameter and 7mm in coronal diameter. There is an area of high density under the wooden face which might be a layer of plaster or resin that was used to support the face to the cartonnage case. Tree rings are visible and clear for any further dendrochronology investigation.

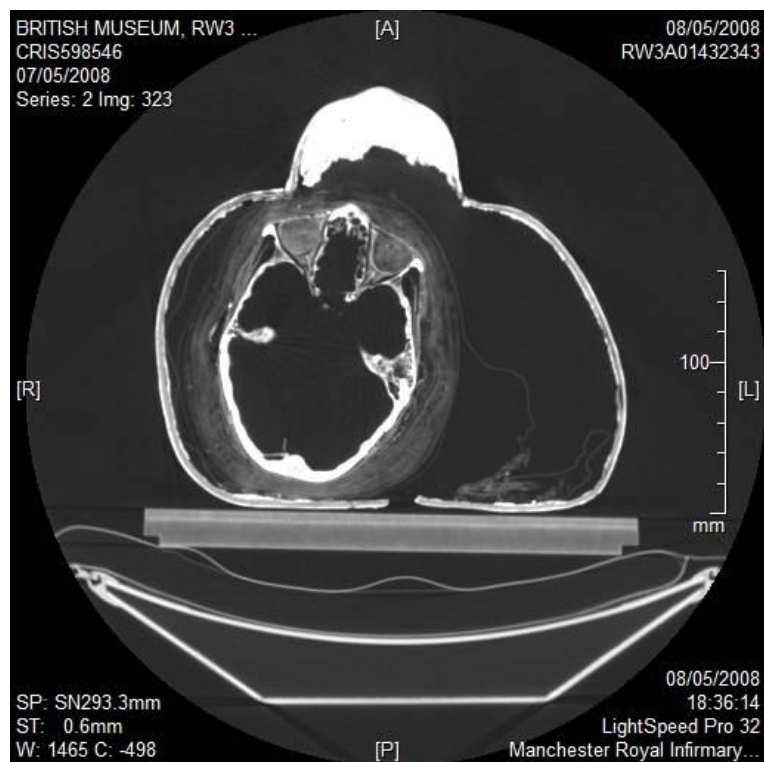


Fig 7.13, EA 25258, CT axial image showing the dense material supporting the back of the face area of the cartonnage case.



Fig 7.14: EA 25258, 3D image of the back of the cartonnage case showing the gap between the two sides of the back slit and the missing laces.

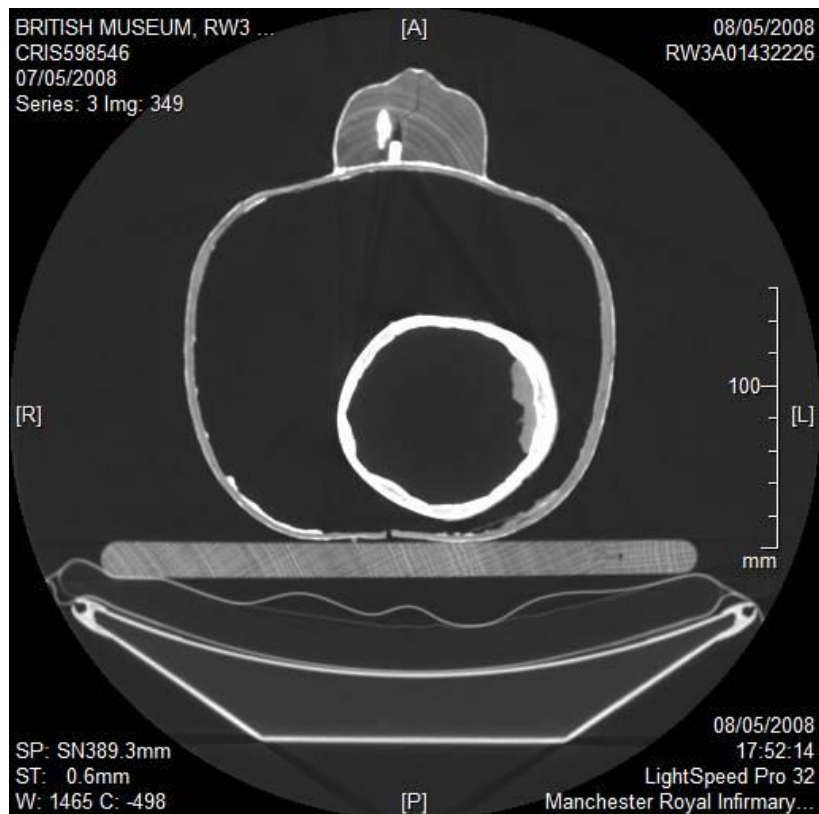


Fig 7.15, EA 29577, CT axial image showing the wooden modelled face of the cartonnage. An oblong crack appears in the middle of the face and two high density (metallic?) objects appear in the cross section. It seems that these two objects were thought to be a false eye and a tooth by Dawson and Gray (1968:12) who reported them to be inside the cranial cavity. This highlights one of the limitations of X-ray radiography; superimposition of structures.

Discussion:

Four cases from this collection had an internal support to the facial features of the cartonnage face area (EA 6681, EA 6682, EA 22393, EA 25258). The material of the support has a high density compared with the rest of the cartonnage. This material can possibly be remains of the core that was used during the manufacturing of the cartonnage case and was left there intentionally by the embalmers to support the detailed delicate facial features. It could also be a layer of plaster that they added for the same reason. It is likely that this technique was introduced after observing some damaged cartonnage cases particularly in the face area.

Two mummies (EA 20744 and EA 29577) had a modelled wooden face which has been attached to the face area of the cartonnage case. One of these wooden faces is gilded, (EA 20744). This particular face had no dense material behind it but it seems that it was attached in place by the plaster applied to the gummed linen layers. No wooden dowels were observed supporting this wooden face. On the other hand , the other cartonnage case with a wooden face (EA 29577) has two metal like objects and what appears to be a wooden dowel that were probably used to support the modelled face in place. It is hard to visually distinguish between the faces modelled and supported by a layer of the core or plaster and the faces that were modelled in wood and then attached to the cartonnage case. It was only through radiological examination that a distinction was made. The CT axial images provide very clear and detailed images which would allow a future study to explore the possibility of a dendrochronological research to determine the date of the wood.

For the cartonnage case EA 20744, Dawson and Gray (1968: 19) suggested that it was made for a fully grown woman but was used for Tjayasetimu who was about 12 years old when she died. It is most probable that the singer at the temple of Amun was perceived by the ancient Egyptian society to be a woman and not a child. This is why she was presented on the cartonnage case as a fully grown up woman. The measurement of the case especially the width of the case (about 40cm wide) would not be enough to house a fully grown wrapped adult mummy. The empty space left inside the cartonnage varies from one mummy to the other but generally the space left empty ranges between 18 and 23cm. The only exception where very little space was left empty is the case of EA 6682 which had an extension to the foot area of the cartonage.

7.4 Mummification techniques and their post-mortem affects on the body:

Certain procedures had to be undertaken by the embalmers in order to preserve the body of the deceased. These procedures were observed and recorded during this study. A detailed description of the observations and results of the examination of mummification techniques for each mummy has been mentioned in the catalogue of the selected collection of mummies in Appendix VI.

Results:

7.4.1- Skull: The radiographic images provided evidence that all the mummies in this collection exhibit a damaged cribriform plate of the ethmoid bone (Fig 7.17) except for one mummy (EA 20744) (Fig 7.16) where another route must have been used for excerebration as the skull does not have any remains of the brain. A layer of resin was observed inside the skull in a few mummies (EA 6659, 6681, 6682, and 29577). In these cases, the horizontal level of the resin layer indicates that the mummy was in the supine position during mummification except for EA 29577, where resin is layered both in the occipital region and the left side of the inner skull vault, suggesting mummification may have been in the supine and left lateral position. The skull appeared empty in a number of cases such as EA 25258, EA 20744, except for some remains of debris which could be bone fragments.

Nasal packages were observed in two cases EA 6681 and EA 22939 where linen wads extended to the cranial cavity following the excerebration route. Evidence that the left side of the ethmoids was used to extract the brain was observed from the skull of EA 22939.

The pituitary fossa was intact in two mummies (EA 6659 and EA 20744) while the dorsum sella was absent in the case of EA 25258. False eyes will be discussed with the foreign objects section.

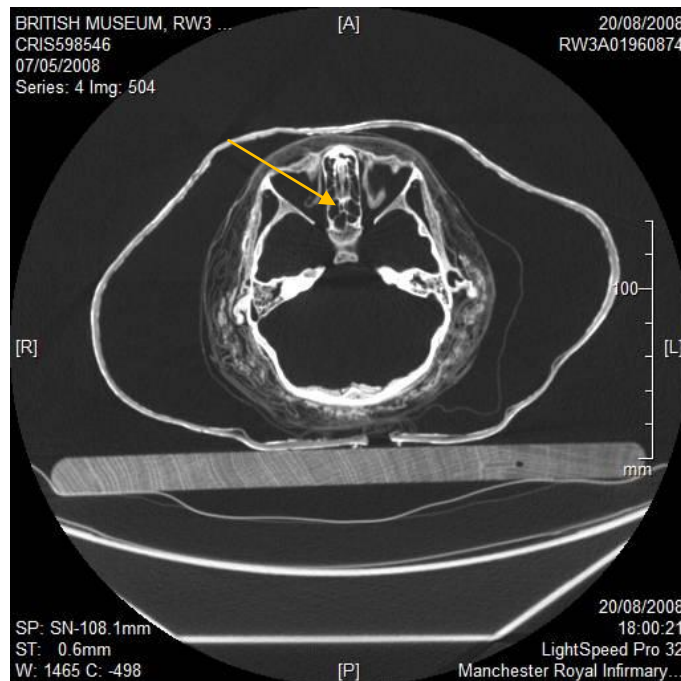


Fig 7.16, EA 20744 Intact cribriform plate of the ethmoid bone indicating that this is not the route taken by the embalmers to extract the brain which is not evident inside the cranial cavity.

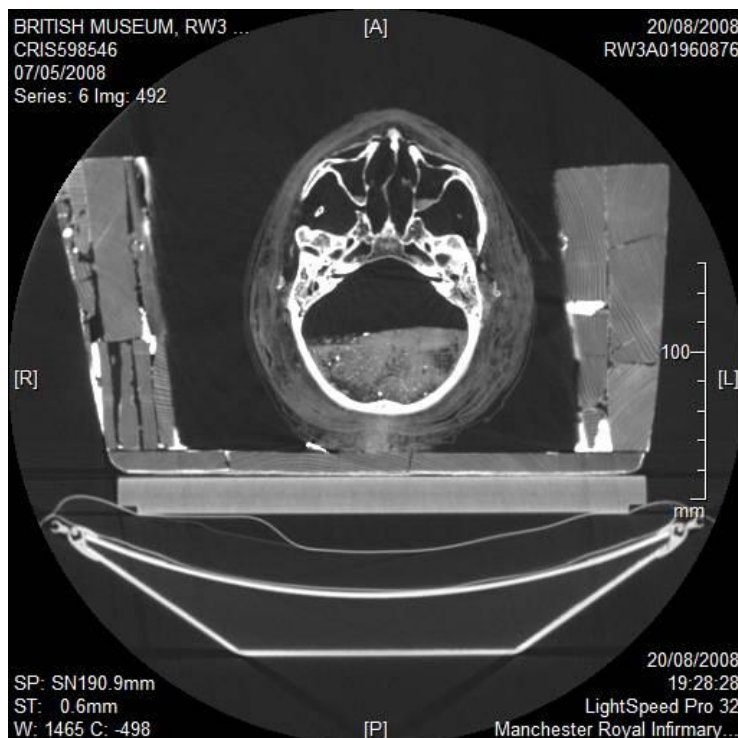


Fig 7.17, EA 6659 CT axial image showing the damaged ethmoids and filling material (probably a combination of soil and resin) inside the cranial cavity.

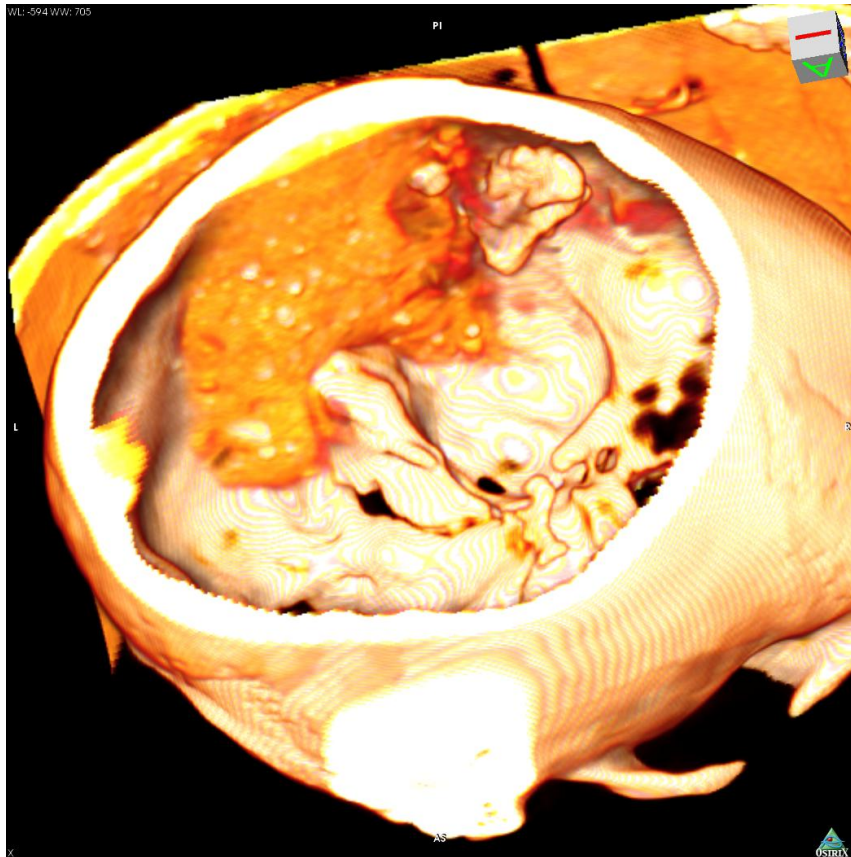


Fig 7.18, EA 29577, 3D image of the interior of the skull showing the remains of what appears to be a combination of sand and resin inside the skull. The filling material is located on the occipital region and the left side of the inner skull vault suggesting two positions during mummification, supine and left lateral position.

7.4.2 Neck:

Evidence of mummification packages in the neck was observed from five mummies (EA 6659, EA 6681, EA 6682, EA 22939 and EA 25258). No evidence of packing was seen in EA 20744 and there was no evidence of the neck in EA 29577.

The neck packages were made of heterogeneous material which had an attenuation value of - 474HU in one case (EA 6681). This indicates low density materials. The package in this particular case measures 4.2cm in sagittal diameter and 7.6cm in coronal diameter. In another case, (EA 22393), the anterior heterogeneous neck pack has an AP diameter of 36mm and attenuation of -54HU and it extends down to the level of the thoracic inlet.

The neck package observed in the case of EA 25258 was also a homogeneous anterior pack with an attenuation of - 487HU. It measured AP diameter = 26mm and coronal diameter = 55mm. It extends into the thoracic inlet where it becomes more heterogeneous (attenuation = - 465HU; AP diameter = 37mm; coronal diameter = 66mm) (Fig: 7.19).

Evidence of damage to the cervical spine was reported from two mummies, EA 6659 and EA 6681. Bead shaped objects (sand particles?) were reported from the wrappings around the neck in EA 6682, where a rod was placed to support the head.

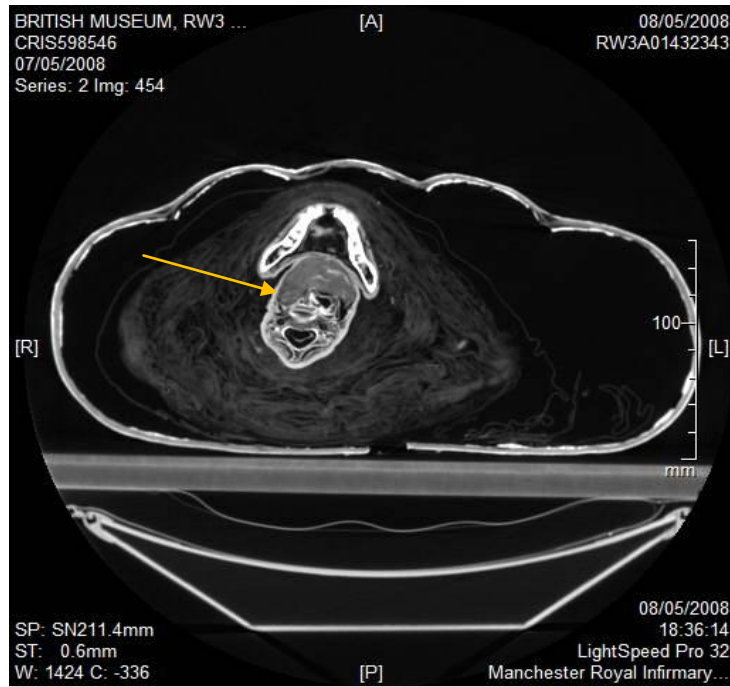


Fig: 7.19 (EA 25258) A homogeneous anterior neck pack with an attenuation of - 487HU. Its AP diameter is 26mm and its coronal diameter is 55mm.

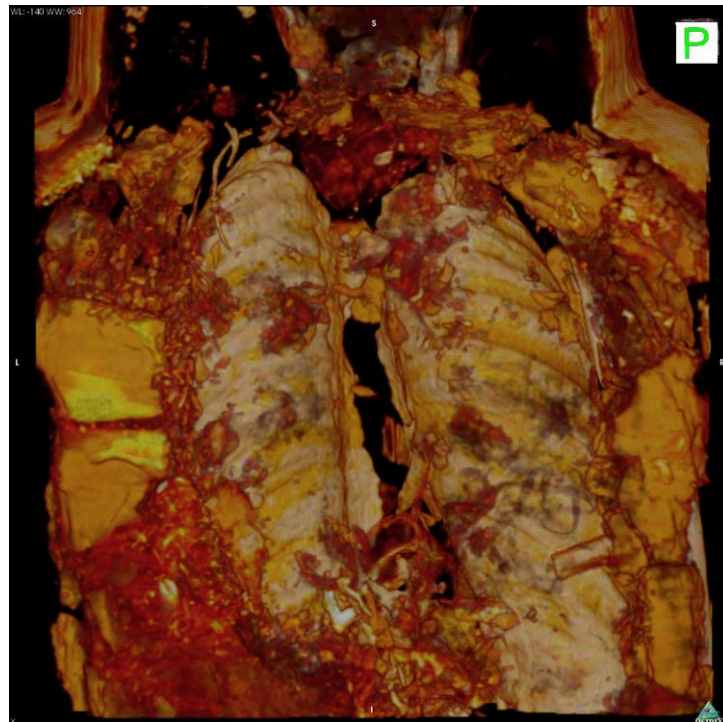


Fig: 7.20 (EA 6681) Two large dense packs occupy the thoracic cavity. Sections of the ribs appear posteriorly indicating that they were articulated when the material of the packages was applied probably in a paste like consistency.

7.4.3 Thorax and abdomen:

The thoracic and abdominal vertebrae were found to be articulated in five mummies (EA 6659, EA 6682, EA 20744, EA 22393 and EA 25258) and disarticulated in two cases (EA 6681 and EA 29577). Evidence of spinal cord was reported from two mummies, EA 6659 and EA 25258. Packages with internal organs were placed inside the thoracic and abdominal cavities in the majority of the cases (for example EA 6659). Post mortem anterior dislocations of the sacrum at the sacro-iliac joint were observed from EA 6682 and EA 20744.

Loose fabric and resin soaked linen were observed inside the body cavities. Some of the packages were placed in the abdominal cavity and some were extending to the pelvic area such as (EA 6659). The thorax of the mummy inside the cartonnage case of *Pef-tauemawy-khonsw*, EA 6681 was filled with two radio-opaque dense oval packages. Further examination of these packages showed that remains of the posterior sections of the ribs are included within these packages which indicate that they were placed when the body was articulated (Fig: 7.20). The maximum length of the package on the left side is 35.9cm and the right side package is 35.4cm. The main component of this dense material is uniform in attenuation (52HU) with a more dense posterior rim (attenuation = 841HU). The maximum attenuation value found on the packages is 1111HU. The minimum density is -787HU which is the value for air indicating that there are voids inside the packages. This particular mummy exhibits missing and dislocated thoracic and lumbar vertebrae.

A left side incision was observed in four mummies, EA 6659, EA 6682, EA 22939 and EA 25258. The length of the incision was about 13 cm long and 7 cm wide in the case of EA 6659 and 10 cm in the case of EA 20744. The incision was left open in the case of EA 6659, while in the case of EA 22939 it was closed and covered with a rectangular metallic plaque.

Poles and supporting rods placed inside the thoracic and abdominal cavities to support the mummy were reported from two cases, (EA 6682 and EA 29577). The supporting poles will be discussed in the foreign objects and amulets section.

7.4.4 Extremities:

Results:

The position of the arms appears to be the same in all the mummies from this collection. The arms are in the prone position and the elbows extended with the hands over the thighs according to the custom during the Third Intermediate Period. This position has been confirmed from the radiographs and CT images for all the mummies except EA 29577 due to its dislocated condition, although the location of the disturbed arms suggests the same position. The mummy of *Pef-tauemawy-khonsw* (EA6681) appears to have suffered damage to the arm as the left ulna appears to be broken. In a number of cases (EA 25258, EA29577), the arms and legs were wrapped separately before they were included within the wrapping, while other cases (EA 6659, EA 6682, EA 20744 and EA 22939) exhibited arms and legs wrapped with the body, without any separate wrappings.

Evidence of subcutaneous packing in the legs was observed in two mummies (EA 6659 and EA 6681). Some loose material was placed between the legs and feet of a few mummies (EA 6659, EA 6681, EA 6682, EA 20744, EA 29577)

Discussion:

The changes that took place during mummification and were observed and recorded during the examination of this collection of mummies correspond in general with the known procedures of mummification practised during the Third Intermediate Period.

The brain was extracted through the nose by piercing through the ethmoids in six of the mummies (only one case of an intact cribriform plate, EA 20744). Evidence from recorded mummies dates back this procedure to as early as 2500 BC (Taconis & Maat 2005: 59). Evidence of using the left side for this operation was recorded from one mummy (EA 22939) which some scholars suggested that it could have been preferred due to religious or ritual reasons (Taconis & Maat 2005: 59).

Mummification techniques:

Resin was observed inside the cranial cavity in a number of mummies from this collection but only one mummy (EA 29577) showed two levels of resin which indicate both supine and left lateral position during mummification. Similar results were reported by Harrison and Abdalla (1972: 11) from the skull of Tutankhamun which has two fluid levels of radio-dense material in the cranial cavity.

No brain tissues were observed during the examination of the cranial cavities from any of the mummies from this collection which reflects the embalmers' meticulous work and attention to detail during this step of the mummification process.

The thoracic and abdominal cavities were extensively filled with packages of treated internal organs or with resin soaked material and packages of what could possibly be a mixture of natron and sand.

It was not possible to confirm the identification of some of the internal organs that were observed inside the packages. For example, EA 6659, in the body cavity, there is a package containing tubular dense structures which may be bowel containing resin. The limitations in the internal organs' identification were also reported by Taconis and Maat (2005: 60).

It has been noted that the lower extremities would remain in good condition if the rest of the mummy was disarticulated and disturbed due to looting. The robbers would search for amulets and precious objects in the upper body, leaving the legs, in most cases, undisturbed.

7.5 Degree of preservation:

Results:

The collection of mummies showed a wide range of soft tissue preservation. The mummy of the priestess, EA 25258, is a good example of well preserved soft tissue especially in the upper legs. Evidence of hair was also reported from the heads of four mummies (EA 6659, EA 6681, EA 20744 and EA 22939). Evidence of spinal cord was observed from the reformatted images of the thorax and abdomen in two mummies (EA 6659 and EA 25258).

Six mummies of the selected group were found to be articulated. However, one mummy (EA 29577) was found to be disturbed and most of the bones were disarticulated whereas another mummy (EA 6681) was missing a number of bones especially from the upper part while the lower part was in a better state of preservation.

Discussion:

The main reason behind the mummification process is the preservation of the body for the afterlife. The mummification techniques used by the embalmers were successful in preserving the soft tissue in most of the mummies from this group. Except for the cases where post mummification damage due to looting took place (EA 6681 and EA 29577), the

mummies are in a good state of preservation. This also indicates high status in the society which allowed the families to afford an expensive mummification for one of the members.

7.6- Paleopathology:

Results:

A few paleopathological cases were detected during this study. A widening of the diploic space of the skull vault appears in three mummies (EA 6659, EA 22939, EA 29577. This could indicate marrow hyperplasia, and suggests that these mummies might have had anaemia or a haemolytic anaemia during life.

A possible case of osteopenia was also reported from EA 29577. A segment of two vertebrae evident in the sagittal plane showing a prominent vertical trabeculae which gives a striated appearance suggests osteopenia through the loss of horizontal trabeculae.

Discussion:

The type of anaemia detected is different than the anaemia caused by dietary deficiency. Haemolytic anaemia is when the body destroys its own methods of defence, the red blood cells. The bone marrow would try to produce more but it would be difficult to keep the number of red blood cells up to a healthy level. This would exhaust the bone marrow and cause the patient to suffer from anaemia. The red blood cells of a person who suffers from anaemia are smaller and paler than the red blood cells of a healthy person (Roberts & Manchester 1995:166). Another cause of Anaemia is iron deficiency in the diet (Roberts & Manchester 1995:166). Other causes of the low number of red blood cells can be due to blood loss, parasitic infection, and chronic disease such as cancer (Roberts & Manchester 1995:166). Evidence of parasitic infections, mainly Schistosomiasis had been reported from Egyptian human remains (Contis & David 1996: 253-255). A strong possibility of cancer was also reported during the examination of Nesperennub, a priest who lived at Thebes during the 22nd Dynasty (Taylor 2004:28). As the mummies from this collection suspected of suffering from anaemia belong to priests who had access to an abundance and variety of food, dietary insufficiency is unlikely to be the cause of the anaemia. It is possible that a parasitic infection caused the low number of red blood cells in the blood as no evidence of other abnormalities was detected from these mummies.

7.7 Foreign objects:

Results and discussion:

7.7.1 False eyes: As the tradition during the Third Intermediate Period, the majority of the mummies from this collection were supplied with a set of false eyes made of different materials. Some have metallic and some appear to have resin soaked fabric false eyes based on the difference of their attenuation values.

EA 6659: The mummy was supplied with two false eyes which are visible in the X-ray and CT images. The false eye on the right side is twisted and appears to be standing vertically. The attenuation values of the material of the false eyes are between 1435 HU and 1772 HU. The false eyes are located backwards deep into the orbital cavities.

EA 6681: The eye globes appear to be large (3.04cm x 2.46cm). False eyes appear in the orbits; lens components are dense (HU = 1694-1872) and measure 18mm in width and 5mm in depth. Posterior to the lens is a round structure forming the false globe; this has a width of 2.75cm and a uniform attenuation of -629HU.

EA 6682: There are false eyes which were probably made of loose folds of fabric (attenuation = - 588HU; diameter 40mm) in the orbital cavities.

EA 20733: The eyes are covered with slightly higher density material, probably resin soaked linen which was used as false eyes.

EA 22939: The false eyes are oval in shape and are made up of three layers; posterior an area of attenuation value of 473.5 HU, then two more anterior and dense sections corresponding to the lens of the native eye. These each measure approximately 3mm in depth and measure 27.2mm in width and have an attenuation of 2081.5HU in the anterior component and 1559HU in the middle component.

EA 25258: Artificial eyes (diameter = 28.7mm) are present in the orbital cavities. These have a low density centre (attenuation = - 508HU), and higher density rim surround (attenuation = 159HU) and a more dense lens (attenuation = 1307HU).

EA 29577: The skull is dislocated and disturbed. Dawson and Gray (1968) reported a false eye in the cranial vault but this proved to be an attachment that was used to support the wooden face to the cartonnage case.

As the results show evidence of false eyes was reported from six out of seven mummies from this collection. It seems that this tradition was one of the strong and strictly followed mummification techniques by the embalmers during the Third Intermediate Period. The material of the false eyes varied from metallic (high density), probably gold, to resin soaked linen (relatively lower density).

7.7.2 Heart Scarabs:

Two heart scarabs were reported from this selected group of mummies. In the case of EA 6659, the scarab was placed on the lower part of the chest of the mummy. The attenuation value of the scarab is ± 2093 HU. The scarab is 1.96 cm long and 1.76 cm wide.

As for EA 22939, the attenuation value of the scarab is 2066.5HU, and is 23mm in length, 19,6mm in width and 10.8mm in depth.

3D images were produced in an attempt to read any inscription on the base on both scarabs but the results were inconclusive. A similar study was conducted by Jansen *et al* in 2002 to visualise the hieroglyphic inscriptions on nine scarabs inside the wrapped mummies from the Dutch collection. All the nine scarabs were blank and did not contain any inscription (Jansen *et al* 2002: 66). During the 22nd Dynasty, heart scarabs were sometimes left blank with no inscription (Jansen *et al* (2002: 66), unlike the earlier scarabs which were traditionally inscribed with Spell 30B from the Book of the Dead (Taylor 2001:205-206).

7.7.3 Incision Plaques:

Only one incision plaque was reported during this study. The CT scout images of the mummy of Tjntmutengebtui, EA 22939, showed that there is a metallic plate over the side incision which was used by the embalmers to extract the internal organs. Further examination of the CT and 3D images showed that there are two overlapping plaques and not just one. Both plaques are rectangular in shape but one which appears to be metallic has a higher density (attenuation of 2454HU).The higher density plaque measures 46.19 mm in width and

57.35mm in height while the lower density plaque measures 36.52mm in width and 42.34 in height. It is unusual to place two plaques over the incision. This aspect was not reported during the earlier CT examination of the mummy that took place in 1993.

7.7.4 Amulets:

The mummy which contained a large group of amulets within its wrappings is the mummy of Tjentyemutengebtiu, EA 22939. A number of dense amulets were located on the body; winged female deity (neck), winged Horus (chest), scarab (chest), rectangular plaque and bead? (under left upper arm), two rectangular overlapping incision plaques (abdomen), two small figures (abdomen), one winged vulture (pubic area), one winged scarab (feet). A number of these amulets have a very high attenuation suggesting they may be gold. The large number of amulets deposited with this mummy reflects its wealth and high status in the society. This also corresponds with a gilded cartonnage face. It is interesting to note the lack of amulets or scarabs from the mummy of Tjayasetimu, EA 20744 which also has a gilded cartonnage face.

7.7.5 Supporting poles and rods:

A number of supporting rods and poles were detected during this examination from two mummies, EA 6682 and EA 29577.

EA 6682: It appears that there are one large pole and a cane that were used by the embalmers to support the neck and the body which were left in place. These supports only appear in the CT axial images and do not appear on the CT scout or X-ray images. In the left oropharynx, it becomes evident that there is a supporting pole which measures 13mm in diameter and has a lower density centre (attenuation = - 514HU) and a thin, more dense rim (attenuation = - 260HU). This measures 239.8mm in length and its material is possibly wood. This support or pole is surrounded by packing 8.5 mm in diameter and it extends down inferiorly through the left side of the neck and into the left anterior mediastinum. The length and diameter were calculated from the number of slices that the poles appeared in and this was multiplied by the thickness of each slice, 0.6mm.

Another method used to confirm the measurements, namely is by subtracting the slice location numbers where each pole appears and disappears in the axial images within the mummy. Another support (a curved cane?) that extends from the neck to the left shoulder was observed from the CT axial images. This support is about 12.3 cm long. The diameter of this support is 1.6 cm. Dawson and Gray (1968: 15) observed packing material in the shoulders of this mummy but the poles did not appear on the X-ray images because of their low density. A recent CT study of this mummy in 2005 reported the large wooden pole but not the cane.

EA 29577: In the left section of the thorax, there is a triangular structure which continues to the foot and is obviously a support. It has a central lower attenuation centre (-600 HU) and a higher density rim (483 HU) and measures 27mm in sagittal diameter and 17mm in coronal diameter and may be a reed or more likely a papyrus stem based on the triangular shape of its cross section. A similar structure appears further below on the right side of the abdominal cavity. The two structures continue to support the legs and extend till the heels of both feet. Both supporting structures are evident posterior to the femora.

Discussion:

Similar supporting poles have been reported from mummies which usually date back to a much later period. Smith and Dawson (1924: 124) reported a number of cases where a pole was used to support the mummified head (Fig: 7.21). They attributed the use of the supporting pole to advanced levels of decomposition as a result of poor mummification which caused the head to separate from the body (Smith & Dawson 1924: 124). They noted that in most of these cases the ethmoids were intact and resin was poured inside the detached skull through the foramen magna. The cases date to the Ptolemaic Period

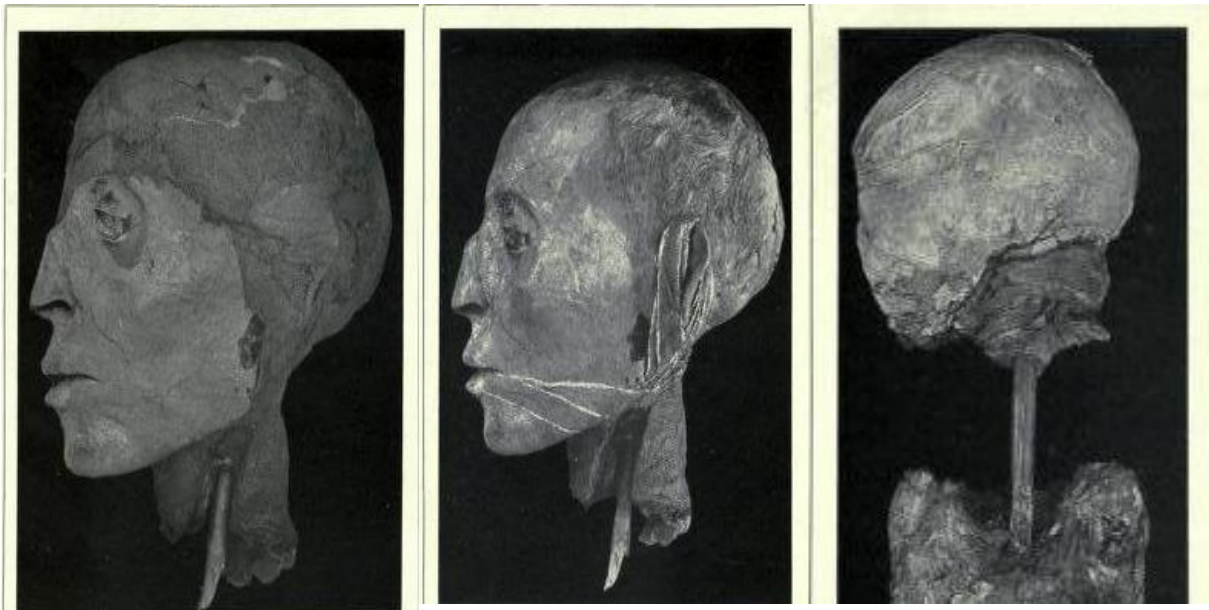


Fig: 7.21 Two adults and a child mummy display the supporting pole still attached to the head. The mummies were discovered in a Roman Cemetery during the archaeological survey of Nubia in 1910.
(From Smith & Jones 1910: Pl XXXIV)

7.7.6 Unidentified bead-like objects:

Results and discussion:

A number of higher density bead-shaped objects were found scattered within the wrappings of a number of mummies (EA 6682, EA 20744, EA 22939 and EA 25258). These high density objects were detected in different places of the body such as the head, abdomen and legs. They could possibly be beads or large sand particles that became attached to the linen bandages during the wrapping process. This may indicate that the wrapping process took place in a mummification tent where the wrappings were partially exposed to the outside environment.

7.7.7 The pottery figure inside EA 6659, the mummy inside the coffin of Hor.

A clay figure was reported following the radiological examination of the mummy of Hor by Dawson and Gray (1968: 21). The figure was removed in 1965 shortly after it was discovered (See above, Chapter Four). Two similar examples were found during the examination of the mummy collection at Leiden (Taconis & Maat 2005: 107, 114). One case is a male (museum inventory no. EG-ZM115) and the other case is a female (museum inventory no. AMM21 or AMM 22), but both date back to the 22nd Dynasty (Taconis & Maat 2005: 107, 114). The first example was found in the abdominal cavity of the female mummy. The figure had cracks on its surface as the figure discovered with Hor (Taconis & Maat 2005: 107). This example was smaller in size (13.2 x 5.5 x 4.1 cm) and its attenuation value is about 810 HU \pm 60 (Taconis & Maat 2005: 107). However, the figure with the male mummy was found in the thoracic cavity inside a dense filling, similar to *Pef-tauemawy-khonsu* (EA 6681) (Taconis & Maat 2005: 114). The figure which measures 13.7 x 6.2 x 4.9 cm has a rough surface and attenuation value of 1190 \pm 50 HU. The material of the two figures was identified as pottery based on attenuation values. No mention was given to any contents inside any of these figures, unlike our case where there is a cylindrical object inside the figure. It seems that the 22nd Dynasty witnessed a short-lived ritual trend of depositing pottery figures during mummification

7.8- Facial reconstruction:

Results:

During this study it was possible to reconstruct the face of one mummy, Tjentmutengebtu, EA 22939. 2D reconstruction of this mummy was produced during an earlier study so a comparison between the 2D reconstruction and the 3D reconstruction was made. The 2D reconstruction was based on 2mm thick CT slices of the skull during the earlier study while the slice thickness during the current investigation was 0.6mm. The 3D image of the skull appears to show more details than the earlier study.

Discussion:

There are similarities between the 2D and the 3D reconstructions such as the angle of the nose. However, the 3D reconstruction provides more detail regarding the width of the face and the shape of the eyes which appear much wider and bigger in the 2D reconstruction. The artist who carried out the 2D reconstruction chose to add hair and skin colour which are unknown information while the current research presented only the confirmed cranial data.

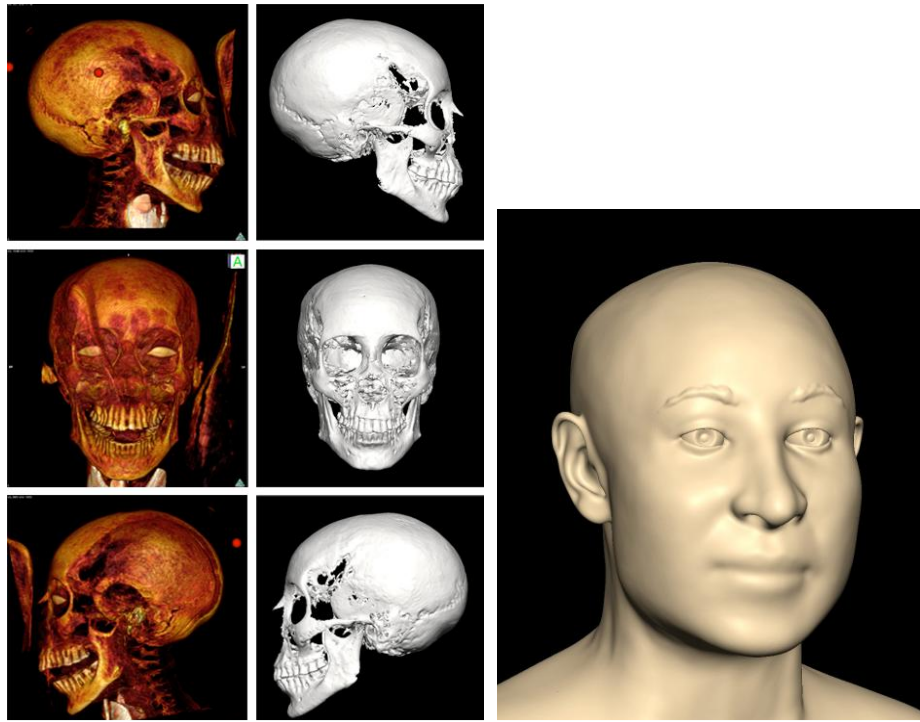


Fig: 7.22 3D images of the mummy, the skull and the reconstructed face of Tjetmutjengebtu, (EA 22939).

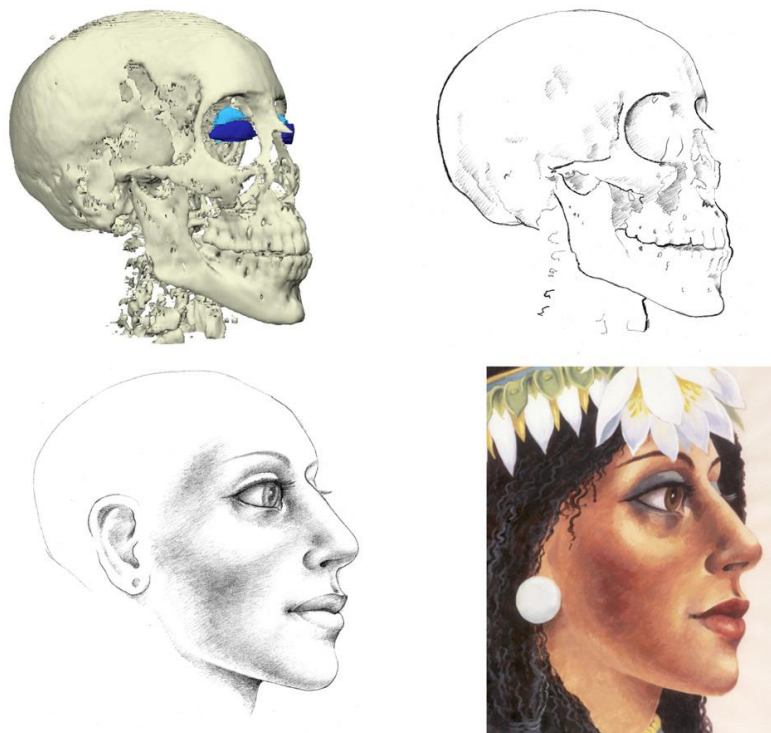


Fig: 7.23 3D reconstruction of the skull with the artificial eyes in blue and 2D artist's impression based on the outlines of the skull showing how she would have looked like during life (from Hughes 2010: 241).

7.9 The dental examination:

The results of the dental examination of the collection during this study correspond with the findings of the majority of researches that were carried out on other collections from ancient Egypt. The collection exhibits all the pathological changes that can be found in modern samples even though refined sugars which are the main cause of modern dental disease were not introduced till after 640 AD (Leek 1972:126). However, the causes of ancient dental pathologies are different from the modern ones due to the difference in the diet. During this research a wide range of dental pathologies were recorded such as, attrition, caries, pre-mortem tooth loss, periodontal disease, malocclusion¹¹⁹ and impact causing rotation of the teeth. Dental hypoplasia was not evident in any of the mummies during this examination.

7.9.1 Attrition:

Results: Different levels of attrition were attested from the mummies during the radiographic examination. A high level of attrition (Class III according to Leek's classification) was reported from EA 6659 which indicated an older age of the individual. Substantial levels of attrition (Class II) were observed from the cases of EA 22939 and EA 25258, while mild attrition (Class I) was detected from EA 6681 and EA 6682, and slight wear (class I) was reported from EA 29577 and very little dental wear was attested from EA 20744 probably due to her young age (around 12 years old). This can also be explained that EA 20744 may have depended on a liquid diet for a length of time. However, no calculus was observed to support this suggestion.

Discussion:

Attrition in the occlusal surface of the teeth had been reported from individuals of a wide age range and different social backgrounds (Leek 1972: 126). When Leek (1972: 128) examined ancient Egyptian bread samples from a number of collections such as Manchester, Turin, Louvre, Leiden, he discovered one of the main reasons behind the various levels of attrition attested from a wide range of ancient Egyptian skulls and mummies. The X-rays showed that the bread contains a percentage of inorganic mineral fragments mixed with the flour during

¹¹⁹ Only one case was reported with malocclusion (EA 6682).

the process of grinding the grains (Leek 1972: 131). Leek (1972: 131-132) mentioned six different ways, starting from the process of growing the seeds until producing a baked loaf, that can cause the bread to be contaminated with inorganic particles. As bread was highly regarded by ancient Egyptians, as the records mention, it was popular between all the strata of the society. The impurities in the bread are the main cause of the levels of attrition attested in almost every sample studied (Leek 1972: 131-132). Another study examined the microscopic differences between the levels and patterns of attrition within the same individual and related them to a number of factors such as eruption sequence and diet (Puech *et al* 1983: 619). The study concluded that some patterns of attrition occurred as a result of a strong occlusal pressure due to mastication of high resistant food (Puech *et al* 1983: 620-621).

7.9.2 Caries:

Results:

There is only one confirmed case of caries observed during this study, from EA 6659. The first lower right molar showed evidence of caries on the mesio-lingual side of the tooth. There is also another possible case of caries in one of the premolar teeth from EA 6681.

Discussion:

As mentioned above, caries was a rare dental pathology to be reported from earlier Egyptian remains. The reason for that, as explained by Puech *et al* (1983:629), was the ancient Egyptian habit of chewing papyrus stems raw, boiled or roasted to extract the juice and spit the quid. This action would stimulate the production of saliva in the mouth which causes a reduction in the number of caries (Puech *et al* 1983:629).

Due to dietary changes, cases of caries started to be more common during the Third Intermediate Period (Harbort *et al* 2008:4). Leek (1979: 75) attributes these dietary changes to foreign cultures being introduced to the ancient Egyptians. A glimpse at the historical background during the Third Intermediate Period provides evidence that the Egyptian society was introduced to foreign, Libyan and Nubian, cultures which no doubt affected the eating habits.

For example, when Leek (1979: 75) reported his findings following the dental examination of the Manchester University Museum collection, most of the caries reported were from teeth belonging to the Ptolemaic Period.

7.9.3 Missing teeth:

It is very common to report missing teeth from ancient Egyptian mummies. The majority of the missing teeth were lost post-mortem while evidence of closed alveoli and bone remodelling from CT Axial images and X-ray radiographs supports that a number of teeth were lost during life. During this research and while examining the radiographs of the teeth belonging to EA 6681, it was noted that the first molar on the lower left side is missing pre-mortem, as evidence of bone remodelling is visible from the CT images.

Some teeth were pushed from their place during the mummification process. This can sometimes take place during extracting the brain from the nose. Some loose teeth were found inside the skull cavity (see below) while a number of teeth were found in different locations around the body and were observed as far as next to the tibia.

7.9.4 Malocclusion due to incisor crowding:

Result:

Only one case of malocclusion was observed during this study. A malocclusion or winging can be seen in the mandible of Padiamunet, EA 6682 (Fig: 7.24). The right first incisor has impacted on its neighbouring teeth resulting in rotation of the right second and first left incisors. This process took place during life.

Discussion:

Such a case of malocclusion due to the rotation of the incisor are not commonly reported but following a study of the ancient Egyptian remains in the collection of Turin, Satinoff (1972:253) reported a number of cases demonstrating incisor crowding, transposition, tilting and rotations of the teeth. Cases of malocclusion related to aspects of overbite are more commonly reported (for example, the detailed radiological dental study of the collection of the Royal Mummies published in Harris and Wente in 1980. Other studies reported malocclusion, overbite type from individual mummies such as Thekkaniyil *et al* 2000.

7.9.5 Teeth inside the cranial cavity:

Result:

The examination of the teeth of EA 6659 showed that one of the missing teeth is located inside the cranial cavity (Fig: 7.25). The investigation of the teeth also showed that at least one tooth (lower left first molar) was lost during life as evidence of bone remodelling attested.

Discussion:

There is a possibility that the tooth was placed intentionally inside the cranial cavity during the mummification process. This would be an attempt to keep all parts of the body intact and together hoping that the resurrected body will be complete. A recent study of a wrapped mummified Roman head from Thebes showed that three teeth that were lost during life due to periodontal disease were placed inside the cranial cavity during mummification (Harbort *et al* 2008:4). As the tooth was lost during Hor's life and was placed inside the skull it would be possible that the embalmers placed the tooth inside the cranial cavity to give Hor a chance for a complete resurrection.



Fig:7.24 EA 6682- skull of Padiamunet showing evidence of malocclusion in the mandibular incisors.

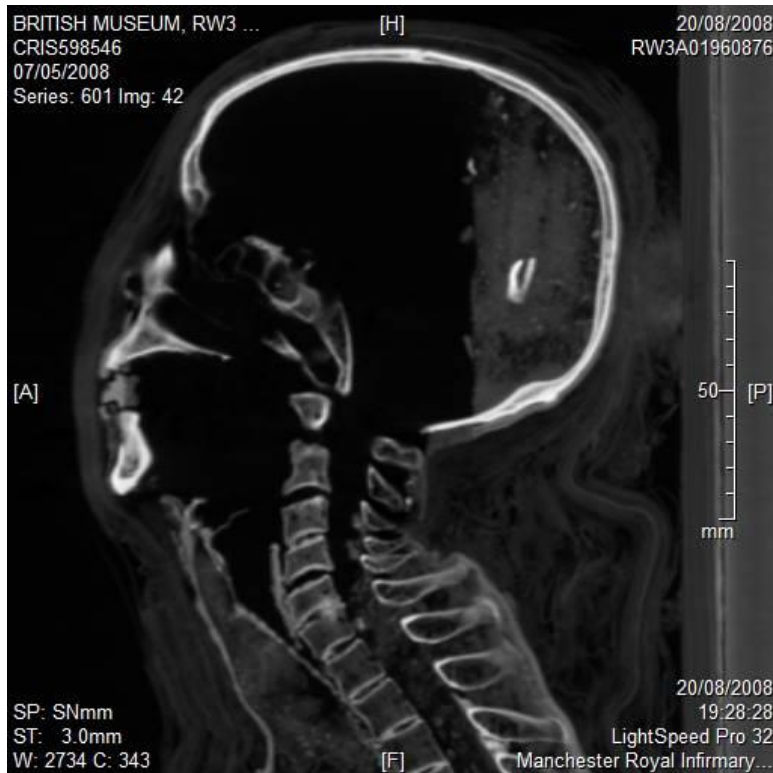


Fig:7.25 Formatted image of the skull and neck of Hor, EA 6659, showing the molar embedded (intentionally?) by the embalmers in the layer of resin inside the cranial cavity.

7.9.6 Dental Health in ancient Egypt:

The results of this research match well with the dental health information obtained during previous studies conducted on ancient Egyptian teeth throughout the different historical periods. As the teeth remain well preserved, they provide a wealth of information about the dental health of ancient individuals which can be compared to the dental records for modern patients (Nunn 2003: 202). The dental profession was known to the ancient Egyptians and there are a few individuals that are known to have worked as dentists such as *Hesy re* who lived during the Third Dynasty and was the chief dentist and physician (Nunn 2003: 202). The ancient Egyptian title associated with the dental practice was *ibhy* (Nunn 2003: 202). Ancient dental tools and teeth with evidence of dental practice are yet to be discovered. However, Leek (1979:76) suggested that there is evidence that teeth were intentionally extracted from adult remains.

While the ancient Egyptians recorded some of their dental cures as evident from the Ebers papyrus, the limitation of translation reduces the amount of information that potentially could be deduced from the ancient text (Nunn 2003: 205). Leek (1979:76) mentions the frequent procedure of treating a dislocated mandible which was mentioned in the Edwin Smith Medical Papyrus (25). The ancient procedure is very similar to the present-day methods (Leek 1979:76). The Ebers papyrus mentions eleven preparations that can be used to provide more strength to the teeth which had been weakened possibly because of periodontal disease (Nunn 2003: 205). Other cures were prescribed for ulcers in the mouth, sharp teeth, due to damage to the crown, and possibly attrition (Nunn 2003: 205). The remedies included honey, cumin, incense and carob (Nunn 2003: 205).

7.10 Miscellaneous:

7.10.1 The dislocated feet (EA 25258):

The CT images show that the wooden board used as a foot board has been attached to the cartonnage by means of what look like modern metal nails which indicate that it is either a replacement or it was reattached to the cartonnage. By further investigation of the area, it became apparent that the wrappings are damaged around the feet area and that the feet are outside the wrapped mummy. The explanation could be that when the foot board was reattached, the feet of the mummy were protruding outside the cartonnage case. If the

attempts of pushing the mummy up in the cartonnage case did not prove possible, dislocating the feet would have solved the problem and the wooden board would have successfully been placed. In addition, if the feet were removed during mummification, the bones would display some evidence of cut marks. No evidence of cut marks was observed from the CT scans or the 3D reconstruction. Dawson and Gray (1968: 11) suggested that the feet were “*carefully dislocated while in advanced stage of decomposition*”. It is also important to note that due to the position of the feet at the left side of the cartonnage, the upper part of the mummy is tilted to the right side of the cartonnage which put pressure on the back slit causing the 5cm gap at the back of the cartonnage.

8. Conclusion and Summary of Finds:

The scientific study of mummies has gained immensely from the use of radiographic technology since it was developed in 1895. The radiographic examination of mummies, which is a non-invasive and essential procedure in any multidisciplinary study of mummified remains, has provided vital and valuable archaeological and medical information. The X-ray and CT scan images can assist in the determination of age, sex, height and ethnicity in addition to the detection of fraud or of the pseudo-mummies that were prepared for the tourism industry during the 18th and 19th centuries. In this study, information about general and dental health, diet, disease and any abnormalities have been demonstrated in the radiographic images; CT scans have provided information about the soft tissue; and amulets, artificial eyes and scarabs are some of the foreign objects that have been observed. Details of the linen wrappings, the degree of preservation of the body, mummification techniques, social class and the lifestyle in addition to dating the specimen, all contribute to a better understanding of life, religious belief and death in ancient Egypt.

All members of this selected group of mummies died under the age of 50. They were of average height. One mummy showed evidence of being well built (EA 25258). The cause of death could not be determined for any of the mummies from this collection. There is a wide range of causes that would not leave any evidence that could be observed visually through the radiographic examination. However, Harris lines were reported from two mummies (EA 20744, EA 29577).

All the fractures and dislocations observed during this study were post mortem, and either took place during mummification or during an episode of looting. Some mummies exhibited well preserved facial features, such as Padiamunet (EA 6682). Two scarabs were recorded from two mummies (EA 6659, EA 22939). A large number of metallic (probably gold) amulets were deposited with the mummy of Tjentmutengebtiu (EA 22939). False eyes were observed in all the mummies except Djedameniufankh (EA 29744), as the skull was dislocated and disarticulated. Furthermore, CT and 3D images of the skull showed that the skull has remains of resin and sand or natron salt but no evidence of the false eye or tooth that was reported by Dawson and Gray (1968: 12) to be located inside the cranial vault.

Regarding the cartonnage cases, a large amount of information regarding their manufacturing techniques was deduced during this study. Wooden faces added to the cartonnages were reported in two examples (EA 20744 and EA 29577). Artificial eyes attached to two cartonnages were also reported (EA 20744 and EA22939). The cartonnage cases that do not have wooden faces have dense material supporting the facial features which is probably plaster or core material intentionally left by the embalmers. The thickness of the cartonnage was noted in different places in each case and the facial area had a thicker layer of plaster than the rest of the body.

Due to the small size of the selected group, as none of the mummies from our group were related, it has not been possible to find examples with similar decoration that would suggest that they came from the same workshop. Although all the cases were found in Thebes and belong to individuals of relatively high status, they exhibit a range of styles and different techniques.

The CT images of the wooden faces, coffin and limbs that were examined as part of this study provided evidence that a further approach to the study of this group of mummies would be desirable. Dendrochronology and the study of tree rings could be undertaken to confirm the dating of these cases which has mostly relied on assessment of the style of the cartonnage decoration.

The enormous number of CT images that became available during this study proved to be very useful, especially for producing high quality 3D images and rotations. It also provided an accurate 3D reconstruction of the skull which was the basis for the facial reconstruction of one mummy (EA 22939). In examining each image, it was important to focus and concentrate only on the specific elements that were required in order to achieve certain objectives.

The CT images provided information regarding the manufacturing techniques of the cartonnage cases. The clear evidence and images of the inside surface of the cases that the CT images clearly showed, would have never been achieved without some disturbance of the artefact. The results of the examination of the coffin (EA 6659) also showed the internal structure of the wooden base of the coffin, providing vital information for the restoration of the object. The CT images also are regarded as part of the documentation process of the mummies as it recorded the condition of each mummy at the time of examination.

Furthermore, the CT images supported the link of manufacturing techniques between the north and the south of Egypt during the Third Intermediate Period.

Regarding the techniques of mummification, some interesting aspects were reported during this study such as the tooth that was embedded in the layer of resin inside the skull of the mummy of Hor (EA 6659). If this was done intentionally by the embalmers, this would indicate a strong belief in keeping all the different parts of the body together which is essential for a successful and fully functional resurrection. More radiological research on mummies would provide more information regarding this particular practice.

The CT scans provided reliable 3D images which allowed accurate facial construction to be produced for the mummy of Tjentmutengebtiu (EA 22939). However, observations of areas where bone construction was missing on the 3D images of the skull were reported. These areas could be interpreted as evidence of disease while in fact; it is a common software error. The areas of missing information on the 3D reconstruction of the skull were compared to the CT images to provide confirmation regarding the software error and to prove that the bone is intact in these specific areas. It is important to point to this phenomenon as it might lead to pseudopaleopathology if not carefully investigated.

Egypt was a cosmopolitan and multicultural region which would explain the existence of individuals from a wide variety of ethnic affiliation. During this study, ethnic background of the mummies was investigated. The skull of each mummy was studied from the X-rays and Ct images for ethnic determination. All the adult mummies from this collection showed evidence of Caucasian affiliation probably due to the small number of our group of mummies as it probably does not reflect the diversity of the Ancient Egyptian population during the Third Intermediate Period.

Visual examination of the cases proved useful in many occasions. For example, the cartonnage case of Tjayasetimu (EA 20744) who lived in Thebes showed evidence of northern influences such as the text of the inscription on the case. Similar artistic and technical links between the north and the south were reported such as the golden incision plaque which was found on the mummy of the northern king Psusennes I which is almost identical to the plaque found with his mother, Henuttawy who was buried at Deir el Bahari (Yoyotte 1988:51).

In general, most of the aims and objectives of this study were achieved; some questions were answered but researching mummies always generates further enquiries to be investigated in the future.

9- List of Abbreviations:

<i>Am. Antiq.</i>	American Antiquity, Minasha.
<i>Am. J. Forensic Med. Pathol.</i>	American Journal of Forensic Medicine and Pathology, Hagerstown, MD
<i>AJNR Am. J. Neuroradiol.</i>	American Journal of Neuroradiology, Oak Brook, IL.
<i>Am J Orthod Dentofacial Orthop</i>	American Journal of Orthodontics and Dentofacial Orthopaedics, St. Louis.
<i>Am. J. Phys. Anthropol.</i>	American Journal of Physical Anthropology, Hoboken, NJ.
<i>Am. J. Roentgenol.</i>	American Journal of Roentgenology, Springfield, Ill.
<i>Annu. Rev. Anthropol.</i>	Annual Review of Anthropology, Palo Alto, California.
<i>Ann. R. Coll. Surg. Engl.</i>	Annals of the Royal College of Surgeons of England, London.
<i>Anthropol. Anz.</i>	Anthropologischer Anzeiger, Stuttgart.
<i>Ant. Or.</i>	Antiguo Oriente, Buenos Aires, Argentina.
<i>Arch. Chir. Neerl.</i>	Archivum chirurgicum Neerlandicum, Wageningen.
<i>Arch. J.</i>	Archaeological Journal, Tokyo.
<i>Arctic Anthropol.</i>	Arctic Anthropology, Madison.
<i>ASAE</i>	Annales du Service des Antiquités de l'Égypte, Cairo.
<i>Assemblage, Univ. Sheff. Grad. Studs. J. Arch.</i>	Assemblage, University of Sheffield Graduate Students Journal of Archaeology, Sheffield.
<i>Austr. Radio.</i>	Australian Radiology, Sydney.
<i>Biblic. Archaeol.</i>	The Biblical Archaeologist, Atlanta.
<i>BIFAO</i>	Le Bulletin de l'Institut Français d'Archéologie Orientale du Caire, Cairo.
<i>BMMA</i>	Bulletin of the Metropolitan Museum of Art, New York.
<i>BMSAES</i>	British Museum Studies in Ancient Egypt and Sudan, http://www.britishmuseum.org/research/online_journals/bmsaes.aspx
<i>Br. J. Radiol.</i>	British Journal of Radiology, London.
<i>Bull. Arch. Surv. Nubia</i>	Bulletin of the Archaeological Survey in Nubia, Cairo.
<i>Bull. N. Y. Acad. Med.</i>	Bulletin of the New York Academy of Medicine, New York.
<i>Cancer (Hoboken, NJ, U. S.)</i>	Cancer, Hoboken, NJ, United States.
<i>Can. Med. Assoc. J.</i>	Canadian Medical Association Journal, Toronto & Ottawa.

<i>Clin. Anat.</i>	Clinical Anatomy, New York.
<i>Clin. Imaging</i>	Clinical Imaging, New York.
<i>Clin. Radiol.</i>	Clinical Radiology, Edinburgh, Oxford.
<i>EA</i>	Egyptian Archaeology, London.
<i>Forensic Sci. Int.</i>	Forensic Science International, Lausanne, & Limerick.
<i>Gerontology</i>	International Journal of Experimental, Clinical, Behavioural and Technological Gerontology, Basel, New York, Karger.
<i>GM</i>	Göttinger Miszellen, Göttingen.
<i>Homo</i>	Homo: Internationale Zeitschrift für die Vergleichende Forschung am Menschen (or Journal of Comparative Human Biology), Stuttgart, Jena.
<i>Int. J. Cancer</i>	International Journal of Cancer, Geneva, New York.
<i>Int. J. Ost.</i>	International Journal of Osteoarchaeology, Chichester.
<i>J. Archaeol. Sci.</i>	Journal of Archaeological Science, London, New York.
<i>JAMA</i>	Journal of the American Medical Association, Chicago.
<i>J. Anat.</i>	Journal of Anatomy, London, Oxford.
<i>J. Am. Inst. Conserv.</i>	Journal of the American Institute for Conservation, Washington.
<i>JARCE</i>	Journal of the American Research Center in Egypt, New York.
<i>J. Bone Jt. Surg.</i>	Journal of Bone and Joint Surgery, London.
<i>J. Brit. Arch. Assoc.</i>	The Journal of the British Archaeological Association, London.
<i>J. Can. Assoc. Radiol.</i>	Canadian Association of Radiologists Journal, Montreal, Quebec, Ottawa.
<i>J. Comput. Assist. Tomogr.</i>	Journal of Computed Assisted Tomography, New York.
<i>J. Dent.</i>	Journal of Dentistry, Oxford.
<i>JEA</i>	Journal of Egyptian Archaeology, Egypt Exploration Society, London.
<i>J. Forensic Sci.</i>	Journal of Forensic Sciences, Chicago, Philadelphia, Pa.
<i>JHS</i>	Journal of Hellenic Studies, London.
<i>J. Hum. Evol.</i>	Journal of Human Evolution, London, New York.
<i>J. Laryngol. Otol.</i>	Journal of Laryngology and Otology, Cambridge.
<i>JMEOS</i>	Journal of the Manchester Egyptian and Oriental Society, Manchester.
<i>JNES</i>	Journal of Near Eastern Studies, Chicago.

<i>J. Paleopath.</i>	Journal of Paleopathology, Chieti, Italy.
<i>J. R. Coll. Surg. Edinb.</i>	Journal of the Royal College of Surgeons of Edinburgh, Edinburgh.
<i>J. R. Anthropol. Inst.</i>	The Journal of the Anthropological Institute of Great Britain and Ireland, London.
<i>J. R. Soc. Med.</i>	Journal of the Royal Society of Medicine, London.
<i>JEOL</i>	Jaarbericht van het Vooraziatisch-Egyptisch Gezelschap Ex Oriente Lux, Leiden.
<i>J. Vis. Commun. Med.</i>	Journal of Visual Communication in Medicine, London.
<i>Lib. Stds.</i>	Libyan Studies, London.
<i>Leg. Med.</i>	Legal Medicine, Tokyo, East Park, Ireland.
<i>Man(Lond)</i>	Man; a monthly record of anthropological science, London.
<i>Med. Hist.</i>	Medical History, London.
<i>MMJ</i>	Metropolitan Museum Journal, New York.
<i>Med. Radiogr. Photogr.</i>	Medical Radiography and Photography, Rochester.
<i>Magn. Reson. Imaging</i>	Magnetic Resonance Imaging, New York, Amsterdam.
<i>Nat. Rev. Cancer</i>	Nature Reviews Cancer, London.
<i>Neurosurgery</i>	Neurosurgery, Baltimore.
<i>Nucl. Instrum. Methods Phys. Res., Sect. B</i>	Nuclear Instruments & Methods in Physics Research, Section B: Beam Interactions with Materials and Atoms, Amsterdam.
<i>OMRO</i>	Oudheidkundige mededelingen uit het Rijksmuseum van Oudheden te Leiden, Leiden.
<i>Osteoporosis Int.</i>	Osteoporosis International, London.
<i>Philos. Trans. R. Soc. Lond. A</i>	Philosophical Transactions of the Royal Society of London, Series A: Mathematical and physical sciences, London.
<i>Phys. Educ.</i>	Physics Education, London.
<i>Postgrad. Med. J.</i>	Postgraduate Medical Journal, London.
<i>Proc. R. Soc. London, Ser. B</i>	Proceedings of the Royal Society of London. Series B, Biological Sciences, London.

<i>Proc. Soc. Bibl. Arch</i>	Proceedings of the Society of Biblical Archaeology, London.
<i>Radiographics</i>	Radiographics: a review publication of the Radiological Society of North America, Inc, Oak Brook, IL.
<i>Radiol. Med.</i>	Radiologia Medica, Turin, Milan.
<i>Rheumatol. Int.</i>	Rheumatology International, Berlin.
<i>SAK</i>	Studien zur Altägyptischen Kultur, Hamburg.
<i>SJH</i>	Smithsonian Journal of History, Washington.
<i>Sci. Mon.</i>	The Scientific Monthly, Washington.
<i>Sci. News</i>	Science News, Washington, D. C
<i>Sci. News Lett.</i>	The Science News Letter, Washington.
<i>Sudan Notes Rec.</i>	Sudan Notes and Records, Khartoum.
<i>Stud. Renaissance</i>	Studies in the Renaissance, New York.
<i>Trans. Odontol. Soc. Gt. Brit.</i>	Transactions of the Odontological Society of Great Britain, London.
<i>Trans. Royal Soc. of Literature</i>	Transactions of the Royal Society of Literature of the United Kingdom, London.
<i>Trans. Soc. Bibl. Arch.</i>	Transactions of the Society of Biblical Archaeology, London.
<i>World Archaeol.</i>	World Archaeology, London.
<i>Yearb. Phys. Anthropol.</i>	Yearbook of Physical Anthropology, New York.
<i>ZÄS</i>	Zeitschrift für Ägyptische Sprache und Altertumskunde, Leipzig, Berlin.
<i>Z. Papyrologie Epigraphik</i>	Zeitschrift für Papyrologie und Epigraphik, Bonn.

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11- Appendices

11.1 Appendix I:

Chronology of Ancient Egyptian History¹²⁰:

Early Dynastic Period:

1st Dynasty	c. 3100-2890 BC
2nd Dynasty	c. 2890-2686 BC

Old Kingdom:

3rd Dynasty	c.2686-2613 BC
4th Dynasty	c. 2613-2494 BC
5th Dynasty	c.2494-2345 BC
6th Dynasty	c. 2345-2181 BC

First Intermediate Period:

7th/8th Dynasties	c.2181-2125 BC
9th Dynasty	c.2160-2130 BC
10th Dynasty	c.2125-2025 BC

Middle Kingdom:

11th Dynasty	c.2125-1985 BC
12th Dynasty	c.1985-1795 BC
13th Dynasty	c.1795-1650 BC

Second Intermediate Period:

14th Dynasty	c.1750-1650 BC
15th Dynasty (Hyksos)	c.1650-1550 BC
16th Dynasty	c.1650-1550 BC
17th Dynasty	c.1650-1550 BC

New Kingdom:

18th Dynasty	c.1550-1295 BC
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¹²⁰ Dynasties and dates for the chronology were compiled from Taylor 2010 and Jansen-Winkel 2006). Names of kings in each dynasty were only given for the Third Intermediate Period as this is the main period discussed during this study.

19th Dynasty	c.1295-1186 BC
20th Dynasty	c.1190-1076 BC

Third Intermediate Period:

21st Dynasty:

Smendes	c.1076-1052 BC
Psusennes I	c.1051-1006 BC
Amenemnisut	c.1005-1002 BC
Amenemope	c.1002-993 BC
Osorkon	992-987 BC
Siamun	986-c.968 BC
Psusennes II	c.967-944 BC

22nd Dynasty:

Shoshenq I	943-923 BC
Osorkon I	922-c.888 BC
Takelot I	c.887-874 BC
Shoshenq II	c.873 BC
Osorkon II	c.872-842 BC
Shoshenq III	841-803 BC
Shoshenq III a	?- 790 BC
Pami	789-784 BC
Shoshenq V	783-c. 746 BC

23rd Dynasty:(Upper Egypt and Rival Kings):

Takelot II	845-821 BC
Iuput I	820-808 BC
Osorkon II, Takelot III	c.780± 20 BC
Petubaste I	834-812-BC
Shoshenq IV, Rudamun, Iny	

23rd Dynasty (Lower Egypt):

Petubast I (?), Osorkon IV	c.730 BC
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24th Dynasty:

Tefnakhte

c.736-729 BC

Bocchoris

728-723 BC

Late Period**c.722-332 BC****Persian Kings****343-332 BC****Macedonian Kings****332-305 BC****Ptolemaic Period****305-30 BC****Roman Period****30 BC- 395 AD**

11.2 Appendix II:

Some Historical Notes related to the Third Intermediate Period:

Sheshonq I (943-923 BC):

The beginning of the 22nd dynasty is marked by the ascension of King Shoshenq I (c 945- 924 BC) to the throne (Taylor 2000:335). Shoshenq, who ruled from the north, was the leader of the Meshwesh, one of the major Libyan tribes (Taylor 2000:335). His title, the “Great Chief of the Meshwesh” was inscribed on a red granite stela found in Abydos by Mariette (Blackman 1941:84). He was the nephew of Osorkon (the Elder), the fifth northern king of the 21st dynasty and his son was married to Maatkara, daughter of Psusennes II, the last High Priest of Amun in Thebes and the northern king of the 21st Dynasty (Taylor 2000:335). The inscription on the Abydos stela (mentioned above), which was clearly commissioned by Shoshenq himself to commemorate the erection of a statue and establishing of a cult in Abydos dedicated to his deceased father, Nemrath, refers to Shoshenq as “*nearly equal partner*” to Psusennes II (Blackman 1941:93).

These family connections paved the way for Shoshenq to ascend the Egyptian throne with little resistance (Taylor 2000:335). Shoshenq, who ruled from Tanis for more than 20 years, chose to continue ruling the whole of Egypt as had his predecessor, Psusennes II (Taylor 2000:335). In order to attain this unity, the post of the army commander and High Priest of Amun at Thebes was given to Iuput, Shoshenq’s son (Taylor 2000:335). However, this arrangement did not result in a centralised administration but only provided stability with one ruling dynasty in both the north and the south throughout the reign of Shoshenq (Baer 1973:4).

Shoshenq’s reign saw Egypt’s position rise once more amongst neighbouring countries (Taylor 2000:335). Towards the end of his reign, c 925 BC, Shoshenq actively interfered in Near Eastern politics and led a large military expedition in an attempt to restore Egypt’s power over the Levant (Taylor 2000:335). Detailed accounts of this expedition were recorded on the walls of the Bubastite Gate which is the only accomplished part of his ambitious plans for expansion at the temple of Amun at Karnak (Taylor 2000:336). According to biblical sources, Nubian and Libyan troops fought side by side during this battle under the Egyptian flag (Taylor 2000:335). However, Egyptian domination in Palestine was not achieved due to the subsequent death of Shoshenq around 923 BC (Taylor 2000:336).

Shoshenq's successors continued losing control over the southern provinces, resulting in decentralisation and autonomy to the regional rulers despite the fact that there was still family connections between the kings in the north and the rulers of the south (Taylor 2000:336). Inscriptions on various monuments provide us with valuable genealogical information regarding powerful positions that were held by members of the same families for decades (Taylor 2000:336).

23rd Dynasty:

It is still difficult to synchronize Manetho's 23rd Dynasty with the evidential information from various inscriptions, regarding the names and lengths of reigns of the kings of this dynasty (Taylor 2000:337). Also, there is no evidence to indicate that any of these kings were related to the 22nd dynasty line of kings (Taylor 2000:354).

The Nubian invasion:

Towards the end of the reign of Shoshenq V, the name Tefnakhte appeared on a number of stelae. His titles started as the Great Chief of the Ma and the commander of the Libu and then progressed further to "The Great Prince of the Entire Land" (Jansen-Winkel 2006:246). It seems that following the relatively long reign of Shoshenq V, Egypt was divided into even smaller states and a number of less powerful kings ruled simultaneously (Jansen-Winkel 2006:246).

Meanwhile, the situation in Nubia was different. For example, Kashta, the ruler of Kush, had authority over Nubia and the south of Egypt as far as Aswan where he was depicted as king of Upper and Lower Egypt (Taylor 2000:353). Kashta's son, Piye, followed his father's policy and extended his authority in the south probably through a treaty with one of the 23rd Dynasty northern kings such as Osorkon IV (Taylor 2000:353).

Piye recorded detailed accounts of his military campaign on a granite stela that was discovered almost complete at Gebel Barkal in 1862 (Taylor 2000:337, Reisner 1921:59). The stela, now in the Egyptian Museum, Cairo, was part of a collection of five stelae that were reported to Mariette by an Egyptian officer visiting the site (Reisner 1921:59). Reisner, the director of the Harvard- Boston excavation team who excavated the site in 1916, suggests that the stelae must have been deposited in a cache at the north of the Temple of Amun at

Barkal (Reisner 1921:60). Reisner did not find any statues of Piye but he discovered, among a large number of stone monuments, a sandstone stela that belonged to Piye and he noticed that his name was erased from both of the stelae before it was re-engraved again, probably in a later period (Reisner 1921:74). Reisner (1917:224) concluded that Piye's construction efforts at the Barkal temples included building the northern chapel and rebuilding the columns in the eastern court.

Evidence from the stela of Piye suggested that Tefnakhte had power over Memphis, Buto and Kom Firin while Leontopolis was under the control of Iuput II, and Osorkon IV ruled the northern cities of Bubastis and Tanis (Jansen-Winkel 2006:246). Hermopolis was under the power of the Libyan king, Nimlot D, and Herakleopolis was in the hands of Peftjauawybast (Jansen-Winkel 2006:247). Mendes was ruled by Djed Amun Iuf Ankh (Spalinger 1979:279). The rising military power of Tefnakhte, who subdued all the cities in the Western Delta and Memphis, continued when he marched with his army towards the northern cities of Upper Egypt; this undoubtedly provoked the Nubian invasion (Spalinger 1979:273).

Spalinger (1979:273-301) gives a detailed account of the progress and different phases of the campaign and how Piye's army captured Memphis and the rest of the northern cities. He also points to the increase in the intensity of "Egyptian nationalism" in the Delta fuelled by the Nubian invasion (Spalinger 1979:274). Tefnakhte progressed from the west, capturing most of the cities on the west bank of the Nile except Herakleopolis which he avoided and never captured (Spalinger 1979:273). He reached as far as the south of Oxyrhynchus before moving to the east of the Nile where he had some support from the rulers of these cities (Spalinger 1979:275).

Nimlot D, who, with his successors Thotemhat and Padimenti (fragments of his Book of the Dead papyrus show his name in a cartouche) (Leahy 1999:230), formed a small ruling dynasty in Hermopolis, was first an ally to Piye before changing sides to become loyal to Tefnakhte when the attack on Herakleopolis started, because he feared that Hermopolis would fall to the power of Tefnakhte (Spalinger 1979:276, Jansen -Winkel 2006:255). It is also recorded that Nimlot D destroyed the walls protecting his own city, Nefrusy, and subdued one of the Upper Egyptian cities (Spalinger 1979:276). It is Nimlot who had declared his alliance with Tefnakhte and clearly not Tefnakhte who trespassed into the Upper Egyptian territories and provoked Piye, who ordered his army initially to attack Hermopolis (Spalinger 1979:276). Jansen-Winkel (2006:262) assigned the years 733 or 734 BC to the Nubian campaign while Depuydt (1993:271) suggests that it took place around 709 BC.

The use of wooden towers as siege equipment for the archers to climb in order to attack the high walls protecting the Egyptian cities was first reported in the Victory Inscription (Spalinger 1979:282). It is not clear how Piye captured Thebes; however, it is possible that a treaty was made with its rulers (Taylor 2000:337).

The surrender of Memphis after a short siege by the Nubian army marked the end of the war and all the other cities of the Delta were subdued (Spalinger 1979:286). A peace treaty was signed by both parties, Piye and Tefnakhte, in Athribis (Spalinger 1979:286). Following these events, Piye did not remain in the north but moved back to Nubia, leaving Egypt to be ruled more or less in the same way it was ruled before his campaign (Taylor 2000:338). His building projects concentrated in Nubia and included construction of the Great Hypostyle Hall in the Barkal temple which is located near Napata, a major Nubian city and cult centre for Amun towards the end of the 8th century BC (Reisner 1921:66, Taylor 2000:353).

Nimlot D is the most likely candidate for the king depicted standing holding a sistrum on the Victory Stela (Jansen -Winkeln 2006:257). According to Jansen-Winkeln (2006:257) it is likely that the Wadi Gasus inscription refers to Year 19 of his reign.

24th Dynasty:

Tefnakhte is considered the founder of the 24th Dynasty. He ruled the majority of Lower Egypt and as far south as the borders of Herakleopolis (Taylor 2000:338). He was succeeded by Bocchoris who was killed by Shabaka, the leader of the second Nubian invasion (Taylor 2000:338).

25th Dynasty:

Shabaka, Shebitku, Taharqo and Tantamani are the kings of this dynasty. Around 716 BC, Shabaka led the second Nubian invasion and enforced his authority over the north after executing the northern king, Bocchoris (Taylor 2000:338). The same political arrangement of the previous dynasty continued during the 25th Dynasty (Taylor 2000:338). The northern rulers were in charge of the Delta and other cities along the Nile Valley as far as Herakleopolis (Taylor 2000:338). The Nubian kings adopted the Egyptian traditions, especially regarding religion, and were portrayed as Egyptian pharaohs with full Egyptian regalia (Taylor 2000:338). To justify and support their claim to the Egyptian throne, they gave high regard to the traditions and trends of the Old Kingdom and made great efforts to restore their glory which was manifested by re-establishing Memphis as their main residential

centre in Egypt (Taylor 2000:338, 355). At Thebes, the post of High Priest of Amun lost its military and civil power and another rank of priestesses called the 'God's Wives of Amun' appeared (Taylor 2000:338). The records tell us of Shepenwepet I, the God's Wife of Amun who adopted Amenirdis I, Piye's sister, to be her successor (Taylor 2000:353). The main duty of the God's Wife of Amun was to maintain the creation cycle and to secure the fertility of the Egyptian soil (Taylor 2000:360). This post was usually held by the daughter of the king who would adopt the daughter of the next in line to the throne to prepare her for this important position, a practice which continued till the end of the 26th Dynasty (Taylor 2000:360). Celibacy was also expected from the holder of this position (Taylor 2000:360). The importance of this position increased dramatically especially during the 23rd dynasty when the God's Wife of Amun appeared in different religious scenes and was almost as important as the king himself (Taylor 2000:360). Ameniridis I was depicted receiving attributes from Thoth and her predecessor, Shepenwepet, was represented with the Double Crown (Taylor 2000:360). There is also evidence that the God's Wife of Amun celebrated the *sed* festival as documented on a relief fragment from Karnak. Such scenes were previously exclusive to kings (Taylor 2000:360). The women who held this position were supported by a number of staff including chief stewards, priests, scribes and "*singers of the chambers of Amun*", a post held by royal daughters (Taylor 2000:360). A number of tombs belonging to the God's Wives of Amun were discovered at the Temple of Medinet Habu (Spencer 2007:50).

During the Nubian period, the post of the High Priest of Amun, which was not occupied for years during the end of the 8th century BC, was re-established and occupied by the king's son but with very little military and civil authority (Taylor 2000:354).

As the Nubian kings embraced the Egyptian religious and cultural traditions, they were depicted in the same style as the Old Kingdom kings and their bodies were mummified when they died. They were buried in Nubia with traditional Egyptian funerary equipment and under pyramids as superstructures for their tombs (Taylor 2000:356). These Egyptian traditions were maintained by the Nubian kings even after their authority over Egypt was long gone (Taylor 2000:356). On the other hand, the Nubian kings used their Kushite names and maintained some characteristic style when depicted, such as the colour of their skin and the hair style (Taylor 2000:356). During the 25th Dynasty, not only the kings but deities such as Isis and Nephthys were sometime depicted with the distinctive Nubian hairstyle (Taylor 2000:356).

One of the important aspects of the religious trends during this period is the obvious rise in the involvement and increased importance of the priestesses in cult practices (Taylor 2000:359). Titles such as “the first great chief of the musical troupe of Amun” were always held by prominent females in the society (Taylor 2000:360).

There was also an apparent decline in the role of the king during different temple ceremonies (Taylor 2000:359). The priestly jobs were inherited and were occupied by members of the same families for years (Taylor 2000:359). During the 21st and 23rd Dynasties, the importance of the position of the High Priest of Amun increased dramatically as this role included having control over the army and administrative civil authorities in addition to its religious supremacy (Taylor 2000:359). The 25th Dynasty witnessed the decline of this important position as its religious authority was transferred to the new position of the God’s Wife of Amun (Taylor 2000:360). The rise of Osiris and the continuation of the cult of the Apis bull in Memphis are the main features of ancient Egyptian religion during this historic period (Taylor 2000:362).

11.3 Appendix III:

Other radiological methods of examination that might be considered for future investigations of ancient Egyptian mummies:

Dual energy X-ray Absorptiometry (DXA):

Dual energy X-ray Absorptiometry (DXA) is a well known technique to measure bone mineral density levels which assist in the diagnosis of osteoporosis and osteopenia (loss of bone mass) (Haigh 2000). Poor diet, osteomalacia, osteoporosis, hyperparathyroidism or cancer could be the cause of osteopenia (Ortner 2003:410).

Recent studies pointed out the possibility of using DXA technique in the examination of ancient populations. Many cases of osteoporosis in ancient Egyptians have been reported (e.g. Logde 1967:407; Benassi & Ragni 1973:47) but a systematic examination with DXA could provide an accurate evaluation of the spread of osteoporosis and osteopenia in the ancient Egyptian population.

In 1993, Lees and her colleagues (1993:673) published the results of the first experiment to estimate bone mineral density (BMD) from archaeological skeletal material. Dual energy X-ray Absorptionmetry (DXA) was used as a non-destructive method of investigation during that research (Lees *et al* 1993:673). Evaluation of the technique has been conducted and the results showed that this technique can be used to gain valuable information about lifestyle, activity levels and nutritional status of the ancient populations (Lees *et al* 1993:673). Female femoral bones from skeletons found in Spitalfield, London were used as anatomical markers during this research (Lees *et al* 1993:673). When the results were compared with modern female bone density levels, it proved to be much higher; this could be explained by the fact that, two hundred years ago, British women might have had a better diet (they probably ate more fresh vegetables and fruit, did more exercise, and were generally more active than present-day women) (Lees *et al* 1993:673).

The first (and, to my knowledge, only) study of ancient Egyptian remains using DXA techniques has been carried out by Haigh in 2000. The material for this study was a collection of un-provenanced dry disarticulated skeletons from the collection of the Egyptian Department at the Manchester Museum (Haigh 2000). Three randomly selected femora from this collection were scanned with a DXA scanner and the results were consistent with the results of the Spitalfield female skeletons (Haigh 2000). Evaluation of the technique has also been conducted and the results showed that this technique can be used, supported by background information or known biography, to gain valuable information about lifestyle, activity levels and the diet of ancient populations. It can also be used to demonstrate differences in bone mineral density across different ages, genders, and social classes in any community. Haigh explained that if the gender of the specimen was known, age determination can be easily and accurately estimated from the BMD value (Haigh 2000).

Haigh (2000) also pointed out that important results could be obtained from further DXA investigations, such as the season of death as the bone mass changes throughout the seasons of the year. Haigh also indicated that the investigation of wrapped mummies or mummies in coffins or sarcophagi using the DXA techniques would be of great interest. She suggested that full body mineral measurements could be carried out using DXA technology and that the examination results could be presented under the heading of “*osteological status*” (Haigh 2000).

It is also important to note here the few recommendations that Haigh mentioned in her publication. She highlighted the importance, when conducting DXA scans for any study, of using the same equipment, since Hologic scanners usually give 29% lower BMD values than Lunar DPX. Also, all the scans should be carried out by the same radiographer who should be highly experienced as the area of interest has to be accurately identified manually on the computer screen (Haigh 2000).

Digital X-ray Radiogrammetry (DXR):

This sensitive radiological technique is used to measure bone mineral density (BMD) and provide information about changes in the bones of an individual during any stage of life (Ward *et al* 2003:390). This technique is as effective as the DXA but less expensive. Radiographs of the hand and the lower part of the forearm are used to calculate the bone mineral density (Ward *et al* 2003:391). The radiographs are scanned on a flatbed scanner and the areas of interest are marked automatically and the average of bone mineral density (BMD) is measured as well as the bone porosity (Ward *et al* 2003:391).

To my knowledge, no studies have been published reporting application of DXR to the investigation of wrapped mummies. There were plans to use the DXA and the DXR techniques during this study but after long discussions with Prof. Adams, it was concluded that it is highly unlikely that this specific type of X-rays would penetrate the cartonnage case made of plaster and gummed layers of linen. Studies on dry bones using the above mentioned techniques are more likely to produce results.

11.4 Appendix IV:

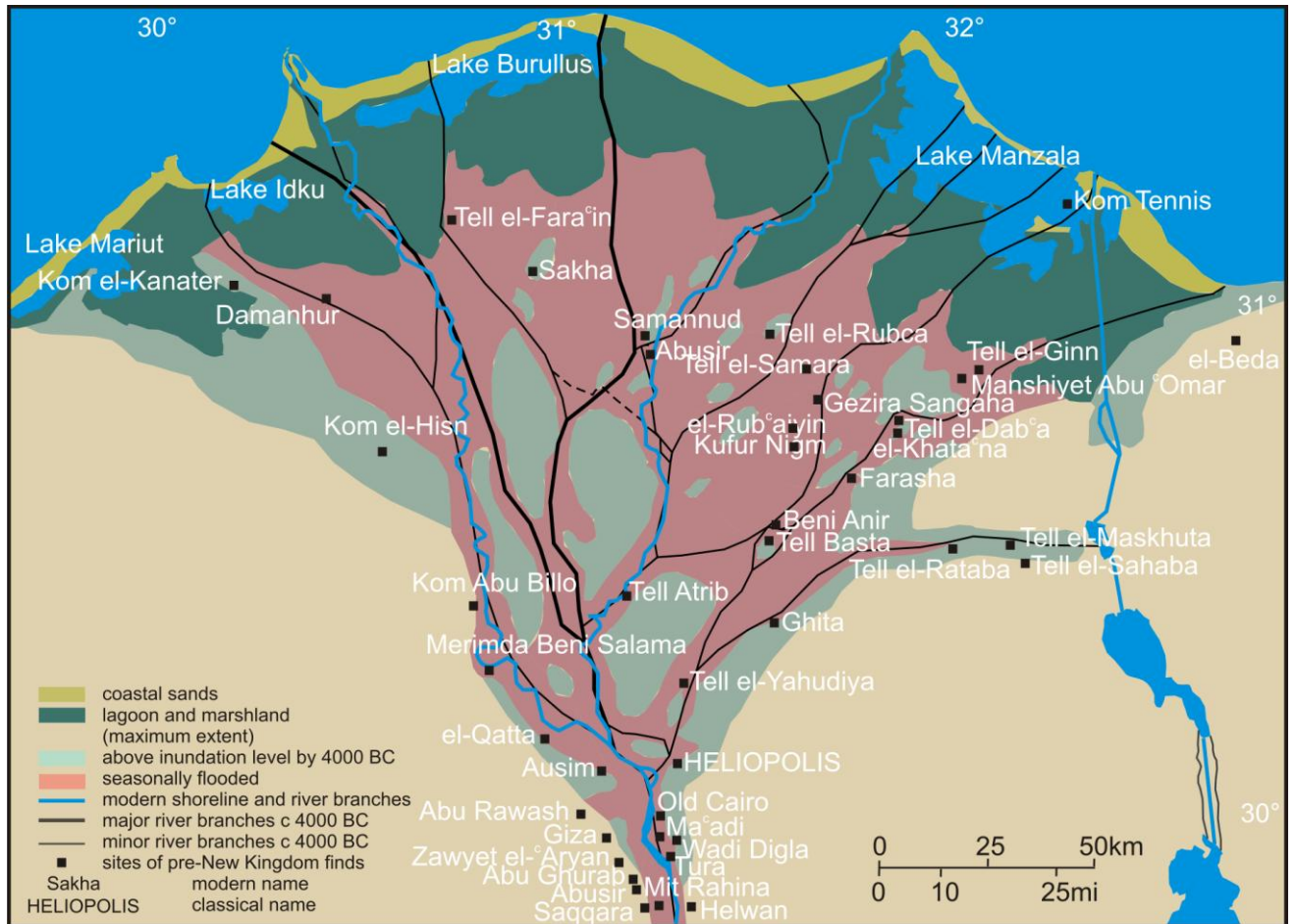
Maps of Egypt:



Map of Modern Egypt with its location in the continent and its political boundaries.
(From Baines & Málek 1984:13)



Map of Egypt showing the major cities of the delta and along the Nile.
(from Taylor 2010:11)

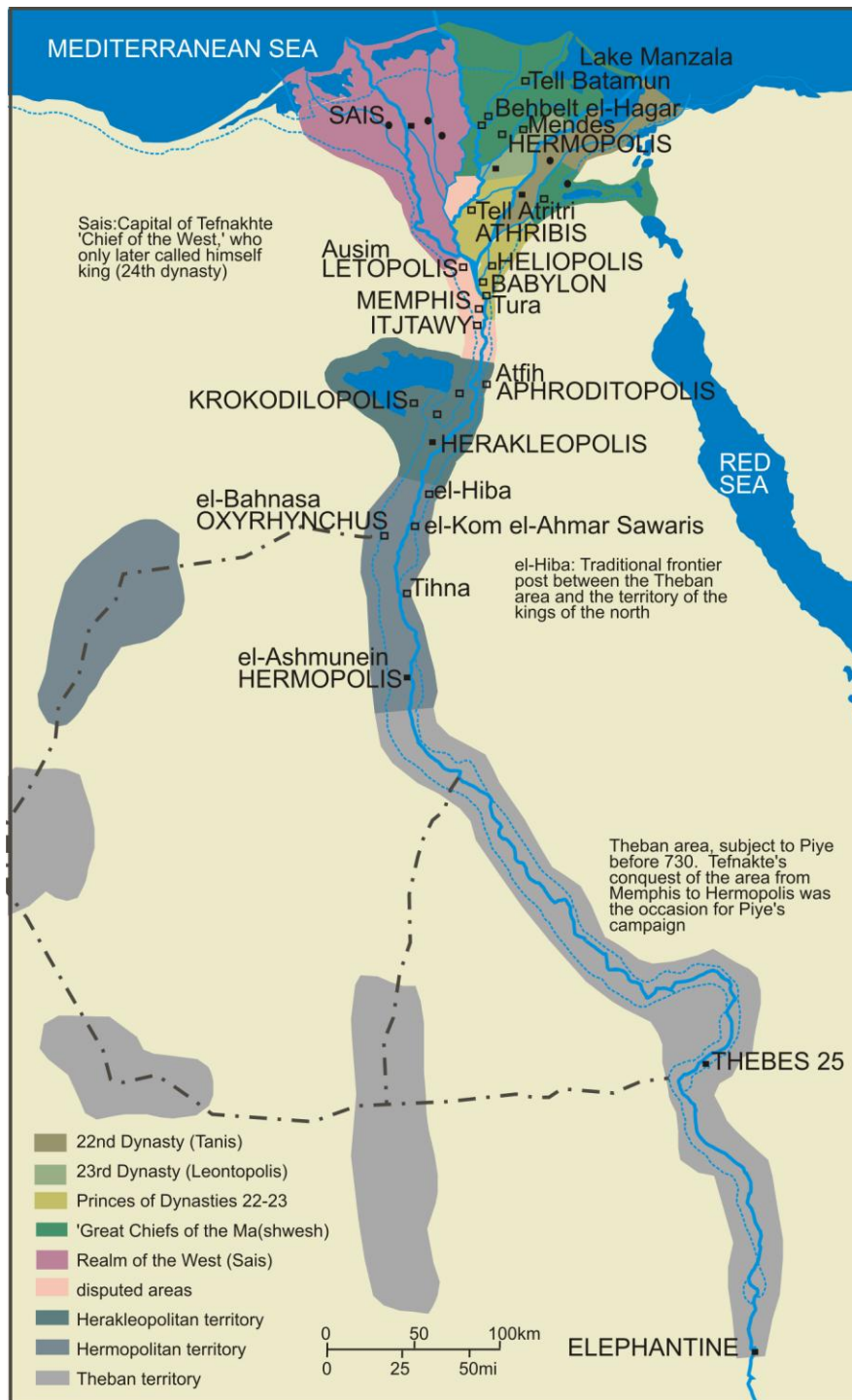


The North

Topographic Map of the Delta showing the major cities.

(From Braines & Málek 1984:18)

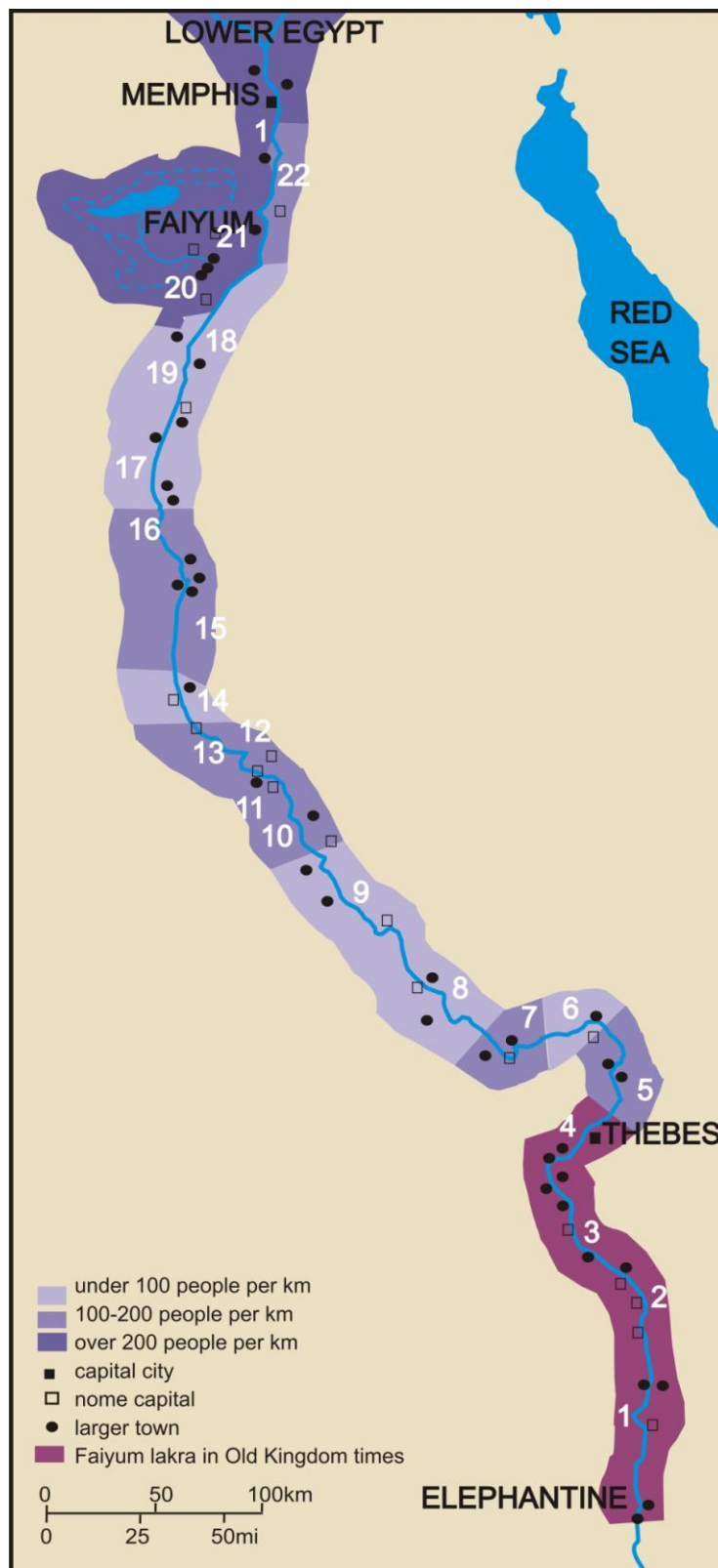
Ancient Egypt during the Third Intermediate Period:



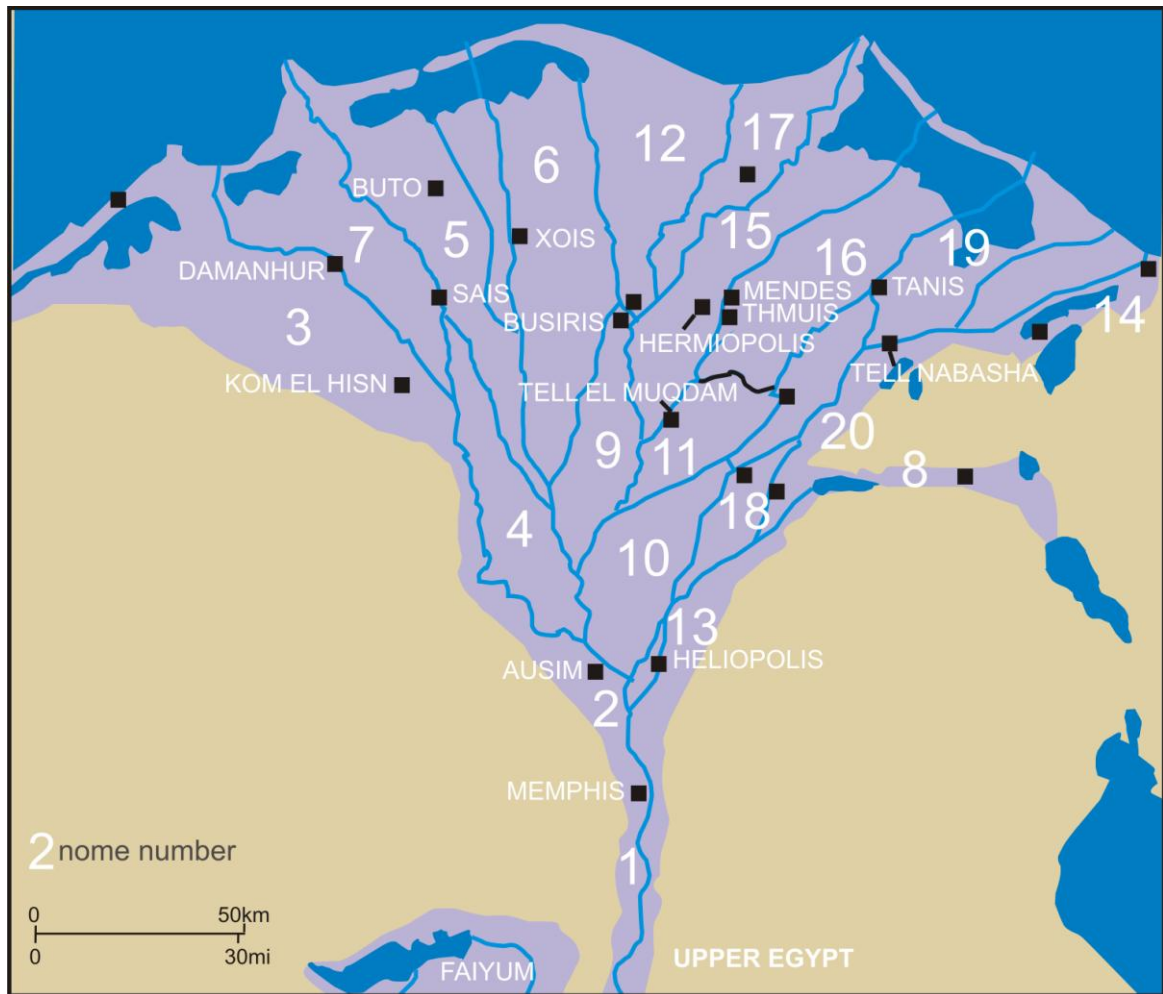
Map of Egypt during the Third Intermediate Period showing the political division around 730 BC.

(From Braines & Málek 1984:47)

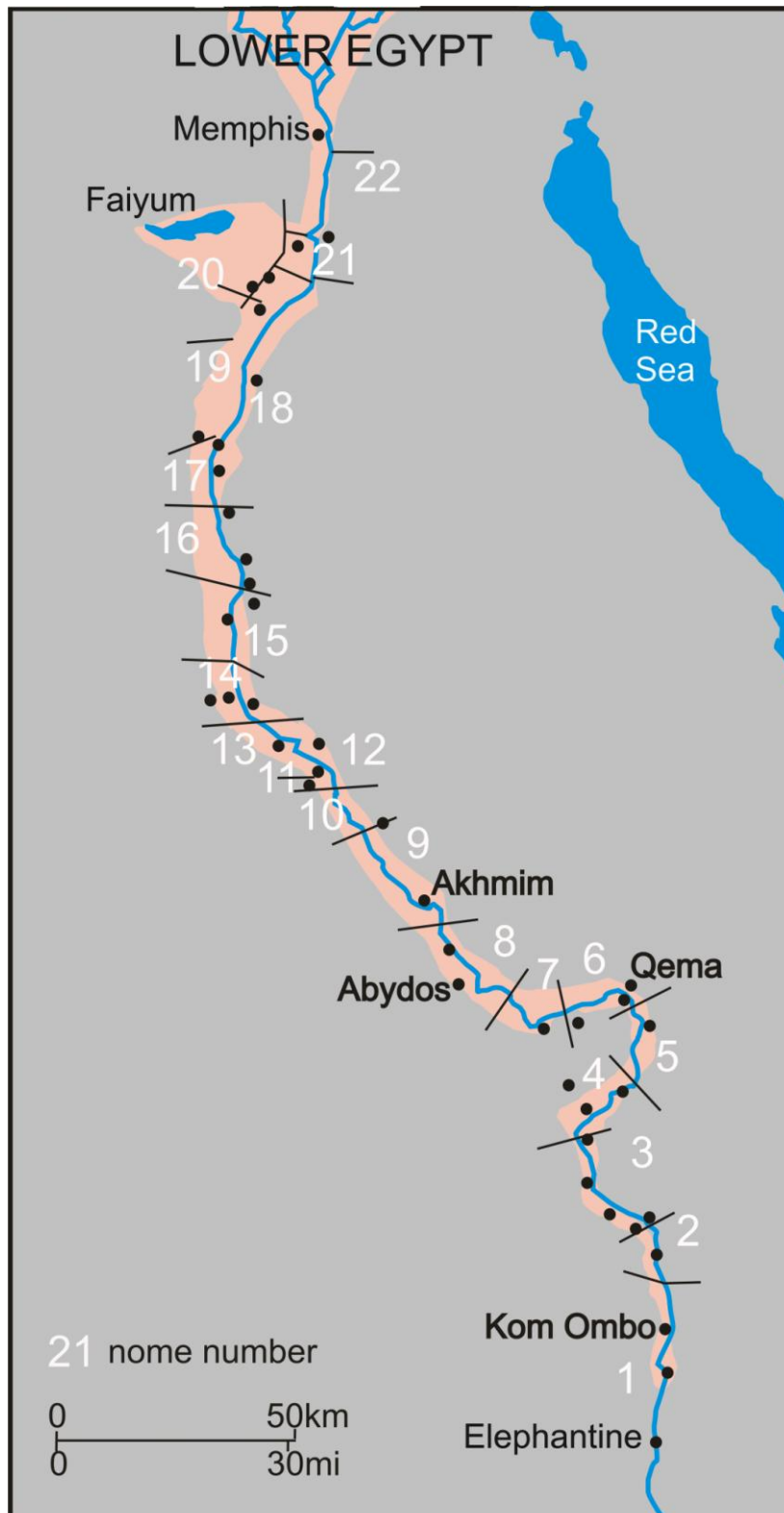
The South:



Map of Upper Egypt showing the distribution of the population in ancient times.
(From Braines & Málek 1984:16)



Map of Lower Egypt showing the nomes of the Delta
 (From Braines & Málek 1984:15)



Map showing the nomes of Upper Egypt.
 (From Braines & Málek 1984:14)

11.5 Appendix V:

List of the Third Intermediate Period Mummies in the British Museum

BM	Name	Association	Bibliography	Comments
6659	Mummy of a middle aged man. The name Hor is inscribed on the coffin.	His mother is Tjaai, and his father is Unnefer.	<p>- Dawson, W.R. & Gray, P.H.K. (1968) <i>Catalogue of Egyptian Antiquities in the British Museum. I. Mummies and Human Remains</i> 21, Pl Xd, XXIc, XXXc. London.</p> <p>-Porter, B. & Moss, R. (1964) <i>Topographical Bibliography of Ancient Egyptian Hieroglyphic Texts, Reliefs and Paintings I (Part 2)</i>, 829. Oxford.</p> <p>-Taylor, J.H. (2001b) Patterns of Colouring on Ancient Egyptian Coffins from the New Kingdom to the Twenty-six Dynasty:an Overview. In W.V. Davies (ed.) <i>Colours and Painting in Ancient Egypt</i>, 172, col. pl. 53. London:The British Museum Press.</p> <p>-Taylor, J. H. (2003) Theban Coffins from the Twenty-Second to the Twenty-Six Dynasty:Dating and Synthesis of Development. In J.H. Taylor & N. Strudwick (eds.) <i>The Theban Necropolis:Past, Present and Future</i>, 108, pl.53. London:The British Museum Press.</p>	<p>Date:Third Intermediate Period</p> <p>Acquisition; It was acquired in 1823 from the collection of Henry Salt.</p> <p>- Artificial eyes are present. Missing teeth. Evidence of circumcision. A pottery figure is visible between the legs, now removed and given the number EA 66849.</p> <p>The mummy was examined during this study.</p>
6660	Mummy of a man of middle age. Resin has been	Priest of Amun	<p>- Porter, B. & Moss, R. (1964) <i>Topographical Bibliography of Ancient Egyptian Hieroglyphic Texts, Reliefs and Paintings I (Part 2)</i>, 829.</p>	<p>Acquisition:The mummy was acquired from the Salt Collection.</p> <p>(mummy could not be moved from the British</p>

	poured on the linen wrappings.		<p>Oxford.</p> <ul style="list-style-type: none"> - Serpico, M. & White, R. (2001) The Use and Identification of Varnish on New Kingdom Funerary Equipment. In W.V. Davies (ed.) <i>Colour and Painting in Ancient Egypt</i>, 34-35, col. pl. 8 [2]. London. - Taylor, J.H. (2001b) Patterns of Colouring on Ancient Egyptian Coffins from the New Kingdom to the Twenty-six Dynasty:an Overview. In W.V. Davies (ed.) <i>Colours and Painting in Ancient Egypt</i> 173, col. pl. 54 [1]. London:The British Museum Press. - Strudwick, N. (2006) <i>Masterpieces of Ancient Egypt</i>, 252-3. London:The British Museum Press. - Dawson, W.R. & Gray, P.H.K. (1968) <i>Catalogue of Egyptian Antiquities in the British Museum. I. Mummies and Human Remains</i>, 10, Pl:Vd, Frontpiece a. London. 	Museum due to unstable condition)
6662	<p>Mummy of an elderly man.</p> <p>The wooden coffin inscribed with the name Djedkhonsiufankh.</p>	Son of Pennestytawy and Nesamun	<p>Dawson, W.R. & Gray, P.H.K. (1968) <i>Catalogue of Egyptian Antiquities in the British Museum. I. Mummies and Human Remains</i>, 12, Pl VIId, XXVIIb,c. London.</p>	<p>Date:21st Dynasty.</p> <p>Acquisition:It was acquired in 1834 from Sams collection.</p> <p>Details of the teeth are poor. No artificial eyes visible (may be obscured). The mouth is closed. The thorax and abdominal cavities are filled with a mixture of sand, sawdust and resin. The four packs of the internal organs are probably embedded in this mixture. Subcutaneous packing</p>

				in the thighs. No evidence of Harris lines. Amulets were detected within the wrappings.
6676	Mummy of Penamunnebnisutwy, Priest of Amun and Bastet,	His father is Nesbanebdjedu and Tahatjret.	<ul style="list-style-type: none"> - The British Museum (1924) <i>Guide to the First, Second and Third Egyptian Rooms</i>, 96. London. - Porter, B. & Moss, R. (1964) <i>Topographical Bibliography of Ancient Egyptian Hieroglyphic Texts, Reliefs and Paintings I (Part 2)</i>, 829. Oxford. - Taylor, J.H. (2001b) Patterns of Colouring on Ancient Egyptian coffins from the New Kingdom to the Twenty-six Dynasty:an Overview. In W. V. Davies (ed.) <i>Colour and Painting in Ancient Egypt</i>, 174, col. pl. 54. London. - Dawson, W.R., Gray, P.H.K. (1968) <i>Catalogue of Egyptian Antiquities in the British Museum. I. Mummies and Human Remains</i>, 18, Pl IXd. London. 	<p>Date:25th or 26th Dynasty</p> <p>Provenance:Thebes</p> <p>Acquisition:The mummy was acquired in 1835</p>
6681	Mummy of a young adult male. The cartonnage mummy-case bears the name Peftjau(em)auikhos, also called. Ankhunennefer.	Son of Djedhoriufankh and Tjentuahmut	<ul style="list-style-type: none"> - Porter, B. & Moss, R. (1964) <i>Topographical Bibliography of Ancient Egyptian Hieroglyphic Texts, Reliefs and Paintings I (Part 2)</i>, 830. Oxford. - Dawson, W.R. & Gray, P.H.K. (1968) <i>Catalogue of Egyptian Antiquities in the British Museum I:Mummies and Human Remains</i>, 11, Pl:VIb and XXVIc. London:The Trustees of the British Museum. - Taylor, J.H. (2001) Taylor, J.H. (2001a) <i>Death and Afterlife in Ancient Egypt</i>, 247 (for the foot 	<p>Date:21st Dynasty</p> <p>The mummy was plundered in antiquity and probably fragments of it were scattered on the ground by the plunderers in their search for jewellery or amulets. An attempt was made to restore the damage:some of the bones were gathered up by the restorer and the whole was consolidated by means of a paste of sand, mud, and resin, which became solidified to form a hard mass. The legs do not appear to have been disturbed. The restorer omitted to insert many of</p>

			<p>board). London:The British Museum Press.</p> <ul style="list-style-type: none"> - Taylor, J.H. (2009b) Coffins as Evidence for a 'North-South divide' in the 22nd-25th Dynasties. In G.P.F. Broekman, R.J. Demarée & O.E. Kaper (eds.) <i>The Libyan Period in Egypt, Historical and Cultural Studies into the 21st– 24th Dynasties:Proceedings of a Conference at Leiden University, 25-27 October 2007</i>:375-415, Pl:I,3. Leiden:Peeters Leuven. 	<p>the vertebrae, which are missing. The mummy was then re-wrapped so as to make a presentable exterior, and put inside the cartonnage case. The remains of the mummy may not be those of the original occupant of the case:it may be a re-used cartonnage to replace that broken by the plunderers. There are also separate fragments of linen, some bearing remains of painted plaster. The mummy was examined during this study.</p>
6682	<p>Mummy of a man, aged 30-40, in a painted cartonnage mummy-case bearing the name Padiamun (Padiamenet).</p>	<p>His father is Usirmose. The wooden coffin of this mummy is (EA 6683).</p>	<ul style="list-style-type: none"> - Anonymous (1999) <i>Art and Afterlife in Ancient Egypt, Japan, 1999-2000</i>, exhibition catalogue, 113. - Dawson, W.R. & Gray, P.H.K. (1968) <i>Catalogue of Egyptian Antiquities in the British Museum I:Mummies and Human Remains</i>, 14, Pl:VIId. London, The Trustees of the British Museum. - The British Museum (1924) <i>Guide to the First, Second and Third Egyptian Rooms</i>. London:124. - Taylor, J.H. (2001) Patterns of Colouring on Ancient Egyptian coffins from the New Kingdom to the Twenty-six Dynasty:an Overview. In W.V. Davies (ed.) <i>Colours and Painting in Ancient Egypt</i>, 173, col. pl. 54. London:The British Museum Press. - Taylor, J.H & Strudwick, N.C. (2005) <i>Mummies:Death and the Afterlife in Ancient Egypt. Treasures from The British Museum</i>, 58-9. 	<p>Date:25th Dynasty Provenance:Thebes</p> <p>Padiamenet worked as an attendant and doorkeeper at the temple of the god Re at Thebes. His father, held the same post. Padiamunet had one son, whose coffins are in Brussels museum collections.</p> <p>A wooden pole used as a support for the head, was detected during a CT examination in 2005.</p> <p>The mummy was examined during this study.</p>

			Santa Ana and London.	
6692	Mummy of young adult female, Takhebkenem, with linen wrappings covered by bead-net of blue glazed composition.	Deceased named on associated coffins EA 6690 A/B, 6691) Daughter of Pedikhnos and Nesmut On display	- Dawson, W.R. & Gray, P.H.K. (1968) <i>Catalogue of Egyptian Antiquities in the British Museum. I. Mummies and Human Remains</i> , 17, Pl:IXa, XXIXb,c. London.	Acquisition:Donated by Christie, Alexander Turnbull (Dr Alexander Turnbull Christie) in 1835. The set of coffins and mummy (EA 6690-6692) were purchased for 'sixty dollars' by Christie from 'Yanni the Greek' (Giovanni d'Athanas) at Alexandria in 1832, as recorded in Christie's diary Provenance:Recorded in Christie's diary as Thebes.
6697	Mummy of an adult female.	(On display)	- Dawson, W.R. & Gray, P.H.K. (1968) <i>Catalogue of Egyptian Antiquities in the British Museum. I. Mummies and Human Remains</i> , 13, Pl:VIIa, XXVIIId. London.	Date:21 st Dynasty The mummy was acquired in 1834 (Sams collection)
15654	Mummy of Bekrenes (older female)	Her Father is Padihor. The coffin has the same number of the mummy (EA 15654).	- Walker, S. & Bierbrier, M. (1997) <i>Fayum. Misteriosi Volti dall'Egitto</i> , 47, 12. London. - Anonymous (1999) <i>Art and Afterlife in Ancient Egypt, Japan, 1999-2000</i> , exhibition catalogue, 114. - Porter, B. & Moss, R. (1964) <i>Topographical Bibliography of Ancient Egyptian Hieroglyphic Texts, Reliefs and Paintings I (Part 2)</i> , 674. Oxford. - Dawson, W.R. & Gray, P.H.K. (1968) <i>Catalogue of Egyptian Antiquities in the British Museum. I. Mummies and Human Remains</i> , 15-16, Pl VIIIb,	Provenance:Sheikh Abd el-Qurna 1869. Acquisition:It was presented by the Prince of Wales Date:25/26 Dynasty

			XXVIIIb,c. London.	
20744	Tjayasetimu A singer of the Interior of Amun, about 12 years old.		<ul style="list-style-type: none"> - Anonymous (1997) <i>Les Amour d'une Princesse Egyptienne</i> [exhibition catalogue]. Saint-Gérard:145, 201. - Anonymous (1999) <i>Art and Afterlife in Ancient Egypt, Japan, 1999-2000</i> [exhibition catalogue], 112. Japan. - Andrews, C. (1998) <i>Egyptian Mummies</i> (2nd ed.), 55, fig. 50. London. - Niwinski, A. (1992) Ritual Protection of the Dead or Symbolic Reflection of his Special Status in Society? The Problem of the Black-coated Cartonnages and Coffins of the Third Intermediate Period. In E. Luft (ed.) <i>The Intellectual Heritage of Egypt. Studies Presented to László Kákossy by Friends and Colleagues on the Occasion of his 60th Birthday</i>, <i>Studia Aegyptiaca</i> 14, 463-464. Budapest. - Dawson, W.R. & Gray, P.H.K. (1968) <i>Catalogue of Egyptian Antiquities in the British Museum. I. Mummies and Human Remains</i>, 19-20, Pl: Xa, Frontpiece b. London. - Taylor, J.H. & Strudwick, N. (2005) <i>Mummies: Death and the Afterlife in Ancient Egypt. Treasures from The British Museum</i>, 56-7. Santa Ana and London. - 	<p>Date; Third Intermediate Period, 22nd Dynasty. Provenance: Thebes, Deir El Bahari. Acquisition: The mummy was acquired in 1888.</p> <p>She was a young woman of high status and her titles mentioned that she was a singer of the Interior of Amun. Therefore, her job would have been to provide ritual music or singing during temple ceremonies at the Temple of Amun. She died at the age of 12 due to unknown causes.</p> <p>The mummy was examined during this study.</p>
22812	Mummy of a male	(coffin) Her father	- Porter, B. & Moss, R. (1964) <i>Topographical</i>	Date: Mummy 21 st Dynasty / Coffin 25 Dynasty

	aged 23-30 in a coffin (EA 22813) belongs to a female, Nestaudjat.	Djedmutiufankh Her mother Djedastiufankh daughter of Horudja	<p><i>Bibliography of Ancient Egyptian Hieroglyphic Texts, Reliefs and Paintings V</i>, 24. Oxford.</p> <ul style="list-style-type: none"> - Walker, S. & Bierbrier, M. (1997) <i>Fayum. Misteriosi Volti dall'Egitto</i>. London:49, 14. - Anonymous (1999) <i>Art and Afterlife in Ancient Egypt , Japan, 1999-2000</i> [exhibition catalogue], 27. Japan. - Dawson, W.R. & Gray, P.H.K. (1968) <i>Catalogue of Egyptian Antiquities in the British Museum. I. Mummies and Human Remains</i> 9, Pl:Vc, XXVIa. London. 	<p>To be included in the 'Musee achemenide virtuel et interactif' (see www.achemenet.com).</p> <p>A good example of subcutaneous packing.</p>
22939	Mummy of Tjentmutengebtu, a priestess, aged 25-40, in painted cartonnage casing with a gilded face	Daughter of Khonsmes and Mehenmut(em)hat	<ul style="list-style-type: none"> - Porter, B. & Moss, R. (1964) <i>Topographical Bibliography of Ancient Egyptian Hieroglyphic Texts, Reliefs and Paintings I (Part 2)</i>, 828. Oxford. - The British Museum (1924) <i>Guide to the First, Second and Third Egyptian Rooms</i>, 84, pl. XIII. London. - Baldock, C., Hughes, S.W., Whittaker, D.K., Taylor, J., Davis, R., Spencer, A.J., Tonge, K. & Sofat, A. (1994) 3-D Reconstruction of an Ancient Egyptian Mummy using X-ray Computer Tomography. <i>J. R. Soc. Med</i> 87:806-808. - Hughes, S.W. (2010) Unwrapping an Ancient Egyptian Mummy Using X-rays. <i>Phys. Educ.</i>45:235-242. - Dawson, W.R., Gray, P.H.K. (1968) <i>Catalogue of Egyptian Antiquities in the British Museum. I.</i> 	<p>Provenance:Thebes</p> <p>Date:21st Dynasty</p> <p>Acquisition:It was acquired by the museum in 1891.</p> <p>Featured in the Television programme “Blue Peter”</p> <p>The mummy was examined during this study.</p>

			<i>Mummies and Human Remains</i> , 8, Pl:Va, XXIVa,b,c. London.	
25258	Mummy of a priestess, middle aged, enclosed in a much larger cartonnage mummy-case		<ul style="list-style-type: none"> - Firth, C.M. (1912) Archaeological Report 1908-9. <i>Bull. Arch. Surv. Nubia</i>, 6:1-8, 184n. Cairo:National Printing Department. - Dawson, W.R. & Gray, P.H.K. (1968) <i>Catalogue of Egyptian Antiquities in the British Museum. I. Mummies and Human Remains</i>, 10, Pl:VIa, XXVIb. London. 	<p>Provenance:Deir el-Bahri Date:Probably 21st Dynasty Acquisition:The mummy was acquired in 1894 Her titles included “Singer of the Interior of Amun”. The mummy was examined during this study.</p>
29577	Mummy of a young adult man, aged about 21-26, in a cartonnage case bearing the name Djedameniufankh		<ul style="list-style-type: none"> - Porter, B. & Moss, R. (1964) <i>Topographical Bibliography of Ancient Egyptian Hieroglyphic Texts, Reliefs and Paintings I (Part 2)</i>, 830. Oxford. - The British Museum (1924) <i>Guide to the First, Second and Third Egyptian Rooms</i>, 121-122 (the name and numbers are incorrect). London. - Taylor, J.H. (2009b) Coffins as Evidence for a ‘North-South Divide’ in the 22nd-25th Dynasties. In G.P.F. Broekman, R.J. Demarée & O.E. Kaper (eds.) <i>The Libyan Period in Egypt, Historical and Cultural Studies into the 21st– 24th Dynasties:Proceedings of a Conference at Leiden University, 25-27 October 2007</i>:375-415. 385,393, 395, Pl:XI. Leiden:Peeters Leuven. - Dawson, W.R. & Gray, P.H.K. (1968) <i>Catalogue of Egyptian Antiquities in the British Museum. I. Mummies and Human Remains</i>, 12,Pl:Vic, XXVIIa. London. 	<p>Date:22nd- 25th Dynasty. Acquisition:The mummy was acquired in 1897. Provenance:Unrecorded. This mummy was plundered and then re-wrapped in antiquity. The mummy was examined during this study.</p>

30720	Mummy of Nesperennub, a priest aged 30-40 years.	His father was Ankhefenkhons whose coffin is part of the British Museum collection, EA 30721. Nesperennub was probably married to Neskhnospakhered whose coffin is in the Hearst Museum of Anthropology, University of California.	<ul style="list-style-type: none"> - Porter, B. & Moss, R. (1964) <i>Topographical Bibliography of Ancient Egyptian Hieroglyphic Texts, Reliefs and Paintings I (Part 2)</i> (1964), 638. Oxford. - Taylor, J.H. (2001b) Patterns of Colouring on Ancient Egyptian Coffins from the New Kingdom to the Twenty-six Dynasty: an Overview. In W.V. Davies (ed.) <i>Colours and Painting in Ancient Egypt</i>, 173, col. pl. 53. London: The British Museum Press. - Taylor, J.H. (2003) Theban Coffins from the Twenty-Second to the Twenty-Six Dynasty: Dating and Synthesis of Development. In N. Strudwick & J. H. Taylor (eds) <i>The Theban Necropolis, Past, Present and Future</i>, 106, pl.49. London: The British Museum Press. - Taylor, J. H. (2004) <i>Mummy: The Inside Story</i>. London: The British Museum Press. - Strudwick, N. (2006) <i>Masterpieces of Ancient Egypt</i>, 254-5. London: The British Museum Press. - Dawson, W.R. & Gray, P.H.K. (1968) <i>Catalogue of Egyptian Antiquities in the British Museum. I. Mummies and Human Remains</i>, 8, Pl: Vb, XXVa,b,c,d. London. 	<p>Date: 22nd Dynasty.</p> <p>Acquisition: The mummy was acquired in 1899 by Budge during one of his missions in Egypt.</p> <p>The anthropoid wooden coffin which has feminine features is inscribed with the name of Nesperennub, son of Ankhefenkhons. His titles were inscribed as “Opener of the Two Gates of Heaven in Karnak, Libationer of the Temple of Khons at Karnak”. The relatively plain coffin has a painted face, blue wig and wide elaborate collar. A vertical line of white hieroglyphic inscription extends down the front of the coffin.</p> <p>The cartonnage case is elaborately decorated. The scenes are arranged in horizontal registers. The fetish of Abydos divides the scenes on the cartonnage symmetrically just under the first register and incorporating a vertical line of inscription that extends from the leg area of the cartonnage down to the feet.</p> <p>This mummy was part of the exhibition: “Mummy the inside story” at the British Museum.</p>
32052	Mummy of a young female, Tatjenef	The daughter of Horkhebi.	<ul style="list-style-type: none"> - Dawson, W.R. & Gray, P.H.K. (1968) <i>Catalogue of Egyptian Antiquities in the British Museum. I. Mummies and Human Remains</i>, 17-18, Pl: IXb, 	<p>Date: 25th or 26th Dynasty</p> <p>Provenance: it was discovered by Garstang at Beni Hasan..</p>

			XXIXd. London.	Acquisition:The museum acquired this mummy in 1904. Beatles were found within the wrapping indicating that the mummy suffered insect infestation sometime during the mummification process.
41603	Infant in cartonnage mummy-case.	(On display)	<ul style="list-style-type: none"> - Garstang, J. (1907) <i>The Burial Customs of Ancient Egypt</i>, 204, 207, fig. 219. London. - Dawson, W.R. & Gray, P.H.K. (1968) <i>Catalogue of Egyptian Antiquities in the British Museum. I. Mummies and Human Remains</i>, 13-14, plate VIIb. London. - Gray, P.H.K. (1969) A Case of Osteogenesis Imperfecta, Associated With Dentinogenesis Imperfecta, Dating From Antiquity, <i>Clin. Radiol.</i> 20:106-108. - Filer, J. (1995) <i>Disease</i>, 63, pl. VI. London:The British Museum Press. - Strudwick, N. (2006) <i>Masterpieces of Ancient Egypt</i>, 250. London:The British Museum Press. - Dawson, W.R. & Gray, P.H.K. (1968) <i>Catalogue of Egyptian Antiquities in the British Museum. I. Mummies and Human Remains</i>, 13-14, Pl:VIIb. London. 	<p>Date:22nd Dynasty</p> <p>Provenance:It was excavated by Garstang at Beni Hasan.</p> <p>Acquisition:The mummy and cartonnage case were acquired by the museum from Frederick George Hilton Price.</p>
48971	Unwrapped mummy of a female (aged 35-48), an unknown priestess	The mummy belongs to an unnamed coffin (EA 48972).	<ul style="list-style-type: none"> - Dawson, W.R. & Gray, P.H.K. (1968) <i>Catalogue of Egyptian Antiquities in the British Museum. I. Mummies and Human Remains</i>, 7, Pl:IVd, XXIIIId. London. 	Provenance:Probably Deir el-Bahri. The mummy and the coffin were gifted to the museum in 1909 by Lady William Cecil (Baroness Amherst of Hackney).

	of Amun.			Date:21 st Dynasty. Left foot almost placed laterally to the body.
74303	Mummy of an adult female		<p>- Serpico, M. & White, R. (1998) Chemical Analysis of Coniferous Resins from Ancient Egypt Using Gas Chromatography/Mass Spectrometry (GC/MS). In C.J. Eyre (ed.), <i>Proceedings 7th International Congress of Egyptologists</i> (Leuven, 1998), 1044-1046, figs. 2-3. Leuven.</p> <p>-Buckley, S.A. & Evershed, R.P. (2001) Organic Chemistry of Embalming Agents in Pharaonic and Graeco-Roman Mummies. <i>Nature</i>, 413:837-841.</p>	<p>Acquisition:The mummy was donated to the museum in 1994 by the Department of Anatomy at St Bartholomew's Hospital. There are no records of its acquisition by the hospital.</p> <p>Date:The mummy was dated to the Third Intermediate Period based on the style of mummification, (internal organs were found wrapped and placed inside the body cavity).</p> <p>Unwrapped and fragmented</p>

- The information in this list is extracted from Marlin, the British Museum Database and from Dawson, W.R. & Gray, P.H.K. (1968) *Catalogue of Egyptian Antiquities in the British Museum Volume 1 Mummies and Human Remains* London:The Trustees of the British Museum.
- All the mummies in this list were X-rayed by Gray except EA 74303 since it arrived in the museum in 1990.
- For further information on the mummy of Nesperennub (EA 30720), See Taylor, J.H. (2004) *Mummy:The Inside Story*. London. British Museum Press.

11.6 Appendix VI:

Catalogue of the Selected Group of Third Intermediate Period Mummies

Cat. No. 1:Mummy inside the coffin of Hor:

Museum Inventory Number:EA 6659 (mummy and coffin)

Acquisition: The coffin and the mummy inside it were purchased in 1823 from the first collection of Henry Salt (1780-1827)¹²¹.

Associated objects: Clay figure EA 66849- less than 20 cm¹²² found between the legs of the mummy during previous radiological examination and retrieved.

Provenance: Unknown but Taylor (2003:108) suggests that it is Theban, based on the style of the coffin.

Date: 22nd Dynasty, according to the style of the coffin (Taylor 2001:172)¹²³

Dimensions: Wrapped mummy: Length = 164 cm¹²⁴, Coffin:Length = 186 cm¹²⁵

Bibliography:

- Porter, B., Moss, R. (1964) *Topographical Bibliography of Ancient Egyptian Hieroglyphic Texts, Reliefs and Paintings I (Part 2)*, Oxford:829.
- Taylor, J. H. (2001) Patterns of colouring on ancient Egyptian coffins from the New Kingdom to the Twenty-six Dynasty:an overview. In W.V. Davies (ed.) *Colours and Painting in Ancient Egypt*, London, The British Museum Press:172, col. pl. 53
- Taylor, J. H. (2003) Theban coffins from the Twenty-Second to the Twenty-Six Dynasty:Dating and Synthesis of Development. In J. H. Taylor and N. Strudwick (eds.) *The Theban Necropolis:Past, Present and Future*, London, The British Museum Press:108, pl.53.
- Dawson, W.R., Gray, P.H.K. (1968) *Catalogue of Egyptian Antiquities in the British Museum I:Mummies and Human Remains*, London, The Trustees of the British Museum:21. Pl Xd, XXlc, XXXc.

Radiological analysis: Conventional X-rays, AP and lateral views, spiral CT axial scans in addition to projection scout views, reformats and 3D images. The radiological study took place in August 2008. A total of 21 X-ray images were produced (skull 4, thorax 5, pelvis 3, thighs 3, knees 2, feet and ankles 4). A total of 3000 CT axial images were produced during the CT examination.

¹²¹ Salt was the British consul in Cairo and his collection was formed by Belzoni (1778-1823), his agent in Egypt. For further information on Salt's First Collection see Moser 2006:93-124.

¹²² Dawson and Gray (1968:21) mentioned that the figure is less than 8" long.

¹²³ According to Gray (1972:200), the mummy was excluded from his study of the position of the arms and hands of the mummies due to the uncertainty of its date.

¹²⁴ Total length of the wrapped mummy was confirmed from the AP scout image, using the "CT lumbar spine" window option in the Dicom viewer. The measurement corresponds with that mentioned by Dawson and Gray 1968:21 and the same measurement was also recorded at The British Museum Online Database: (http://www.britishmuseum.org/research/search_the_collection_database/search_object_details.aspx?objectId=117337&partid=1&IdNum=6659&orig=%2fresearch%2fsearch_the_collection_database%2fmuseum_number_search.aspx).

¹²⁵ Measurement of the coffin was taken from the AP and LP scout images taken during the CT scanning.

Physical anthropological data:

Sex: Male.

Age: between 35-45 years old based on dental attrition.

Stature: 162.34 cm \pm 3.218 (Raxter *et al* 2008) calculated from maximum length of femur

The maximum length of the tibia was calculated from the cross-sections which extend from tibial plateau (section 2198) to distal tibial mid joint surface (section 2759); the difference is 561 sections at 0.6mm each section = 33.66cm which is the tibial length.

164.84 cm \pm 3.002 (Raxter *et al* 2008) calculated from maximum length of tibia.

For comparison, the stature calculated using Totter & Gleser (1952) formula is given below:

Maximum stature: 163.8 cm \pm 3.91 (Totter & Gleser 1952) from femur

167.36 cm \pm 3.96 (Totter & Gleser 1952) from tibia

Exterior description: The mummy is completely wrapped with one large shroud which is folded over the head and feet of the mummy which is secured in place by two dyed bandages that run diagonally from both shoulders. The shroud was also secured by eight bandages around the width of the body from the head to the legs, at similar intervals. There is evidence of blue stripes especially near the edge of the shroud, in the centre, along the length of the body. There are stains on the wrappings especially around the shoulders that correspond with marks on the inside of the coffin. It was possible to examine the mummy while inside the coffin which minimized the handling process, avoiding any further damage to the wrappings, the coffin or the mummy. However, this resulted in excluding the back of the mummy from the examination¹²⁶.

Radiological description: This is the skeleton of an adult male and it is in good condition and appears intact.

Coffin: The CT images showed the internal structure of the wooden coffin clearly. The images showed how the coffin was assembled from smaller pieces of wood that were fixed together by mean of wooden pegs or dowels. The CT images also demonstrated a clear difference between the wood and the plaster layer and showed evidence of internal damage in the sides of the coffin that would not have been possible to detect with visual examination only. Many visible cracks appeared in the CT images in addition to micro cracks that were only visible in the images.

Wrappings: The cross section images reveal the sequence of the wrapping process. For example, around the head, a number of layers of linen appear to wrap tightly around the head followed by some loose layers and then the final layers of linen that wrap the whole body. The wrappings are intact; posteriorly between the scapulae there is a loose fabric package.

Skull: There is a large amount of heterogeneous radiodense resin layered in the occipital region. No brain gyri can be identified inside the cranial vault. The resin layer inside the

¹²⁶ For the description of the coffin, see Chapter four.

cranium contains some debris and one molar that could have found its way into the skull during the process of filling the skull with resin or could have been placed intentionally inside the skull by the embalmers. The resin and debris layered posteriorly in the occipital region indicate that the body was mummified in the supine position.

The ethmoid bones are absent, confirming that the brain was removed via the trans-ethmoidal approach. Resin is layered in the posterior component of the ethmoid air sinuses. There is some thickening of the diploic space of the superior skull vault which may reflect haemolytic anaemia/anaemia with marrow hyperplasia. The pituitary fossa is intact.

A thin layer of hair is present. False eyes are present and have fallen backwards deep into the orbital cavities. The centre of the false eyes is lower in attenuation than the anterior false 'lens'. There is a heterogeneous pack antero-laterally in the neck the attenuation of which lies between -329HU to -419HU with a denser rim (100HU). The pack measures approximately 2.9cm in depth.

Teeth: The teeth exhibit a high level of dental wear which indicates an older age. The third molars are present on the mandible which indicates an age over 21 years. The first molar shows evidence of caries on the mesio-lingual side of the tooth. The lower left first molar is missing pre mortem as there is an evidence of bone remodelling where the roots should have been. The upper right first and second molars are also missing, probably post mortem. It is also possible to estimate the age group by assessing the degree of wear, especially on the third molar which is last to erupt. According to Brothwell's classification, an age of between 35 and 45 would be associated with this level of attrition.

Spine and pelvis: There is disruption of the upper cervical spine segments, probably a post mortem damage. Evidence of the spinal cord is still visible in the reformatted CT images. The pelvis displays characteristic male traits. There is a package in the right side of the pelvis. The sacro-iliac joints are intact. There is a phallus in the scrotal area. There is dense material that extends from the abdomen into the pelvis. The apparent paravertebral linear dense material is due to desiccated paraspinal ligaments adjacent to air and not due to paravertebral ossification.

Thorax and abdomen: The neck package extends into the anterior thorax where it becomes unravelled and tumbles into the left apex. There are considerable contents in the hemi thoraces. Posteriorly on the right there is layered resin. However, on the left, there seems to be a package containing tubular dense structures which may be bowel containing resin. In the right hemi thorax, there is a package with an external wrapping of loose fabric and a high density inner layer which appears to be resin soaked fabric. There is probably another high density package antero-laterally of the thoracic spine on the right.

The embalmers extracted the internal organs through an abdominal incision on the left side. This incision which is about 13cm long is visible on the CT images. It has been left open and measures more than 7 cm wide in places. Beneath this there is a package containing what appears to be resin filled loops of bowel. The internal organs were treated, wrapped and then placed inside the body cavity as part of the Third Intermediate Period traditions in mummification. The packages were visible in the thoracic and abdominal cavities. Resin is layered bilaterally posteriorly.

Extremities: The arms are pronated and elbows extended with the hands pronated over the thighs according to the custom during that period. They are wrapped against the lateral chest

in the major wrappings, not separately. There are no structural changes to the bone joints and they appear to be normal. The femoral heads are normally placed in the acetabulae. The growth plates around the knees are closed. Soft tissue remains visible with some evidence of subcutaneous packing in the legs. Between the thighs there is a heterogeneous package containing 5 rod-like high density structures. The thighs and calves are wrapped separately initially and then wrapped in the main wrappings. Two loose fabric packages are placed between the legs anteriorly and posteriorly above the knees. The knees appear normal with no evidence of arthritis. The wrappings around the left calf are defective anteromedially. The feet are intact with loose fabric packing between the insteps.

Comments:

Genitalia: The CT images show a circumcised penis which confirmed the sex determination.

Post-mortem damage: There is post mortem damage which is likely to have taken place during the mummification process, such as the missing teeth, the damaged ethmoids, the left side abdominal incision and the broken first cervical vertebra.

Foreign objects: The mummy was equipped with two false eyes as visible in the X-ray and CT images. The false eye on the right side is twisted and appears to be standing vertically. The attenuation values of the material of the false eyes are between 1435 HU and 1772 HU. Attenuation values were also recorded for the original eyes, as +295 HU for the left eye and +333 HU for the right eye.

Two small fragments (1.08 cm x 0.4 cm and 0.49 cm x 1 cm) can be seen in the CT images near the mouth. The attenuation values of these two fragments are 69HU and 140HU which may indicate that they are bone fragments.

A scarab has been also placed on the lower part of the chest of the mummy. The attenuation value of the scarab is ± 2093 HU. The scarab is 1.96 cm long and 1.76 cm wide. 3D images were produced in an attempt to read any inscription on its base but the results were inconclusive. During the 22nd Dynasty, heart scarabs were sometimes left blank with no inscription, unlike the earlier scarabs which were traditionally inscribed with Spell 30B from the Book of the Dead.

In conclusion, this is the mummified skeleton of an adult male which is in good condition except for some disruption in the proximal cervical spine. There is no evidence of bone or joint disease, except perhaps some increase in the diploic space of the skull vault raising the possibility of haemolytic anaemia or anaemia with associated marrow hyperplasia. The brain has been removed via the trans-sphenoidal approach and there are false eyes and neck packing. There is a circumcised phallus. The abdominal contents have been removed through an inferior left anterior abdominal incision. There are several packages in the thorax, abdomen and pelvis.



The upper part of the mummy showing the blue strips of the shroud, the transverse bandages around the head and around the shoulders and the dyed diagonal bandages that rest on the shoulders.



EA 6659- The mummy inside the coffin



X-ray image (AP) of the skull and neck.



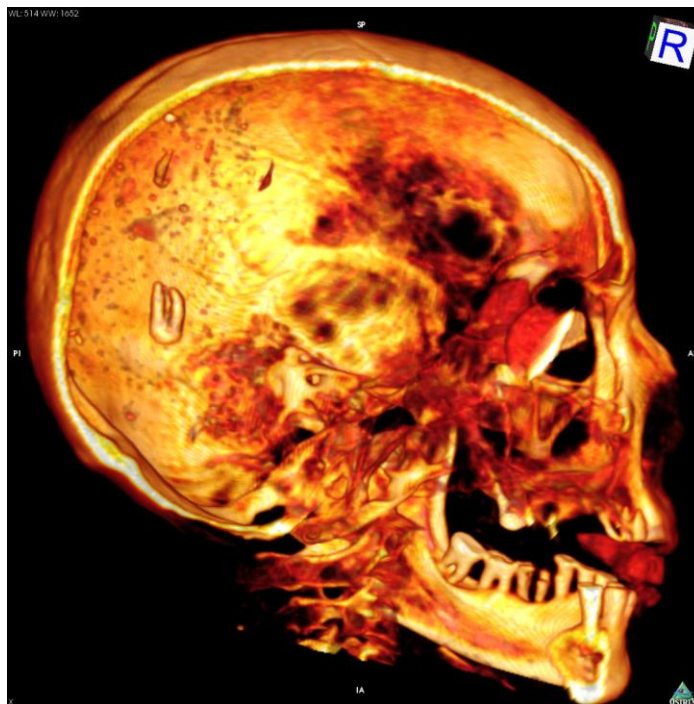
Detail of the dyed doubled linen straps over the large shroud.



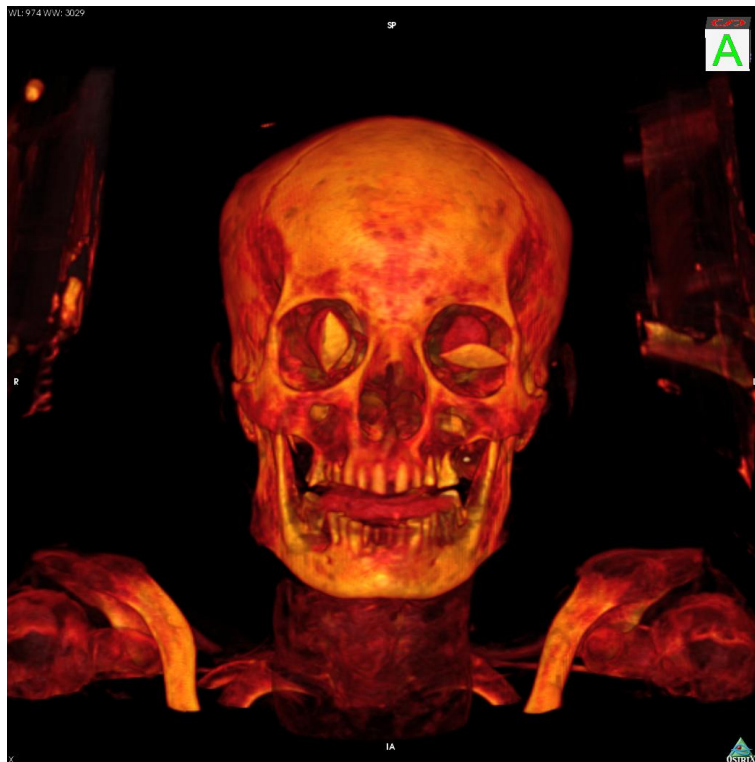
The mummy and coffin on the department's trolley waiting to be placed on the CT scanner platform.



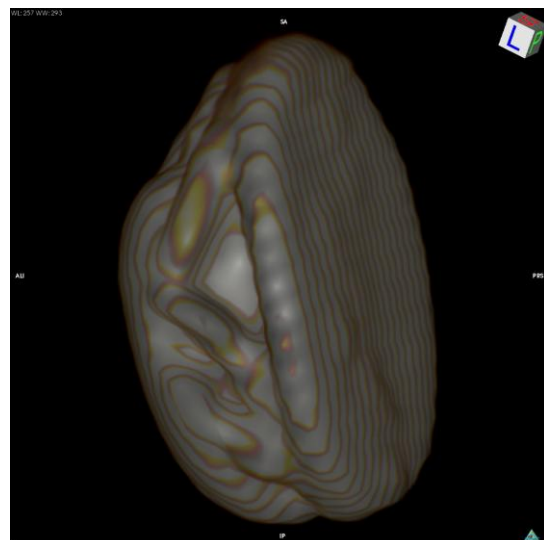
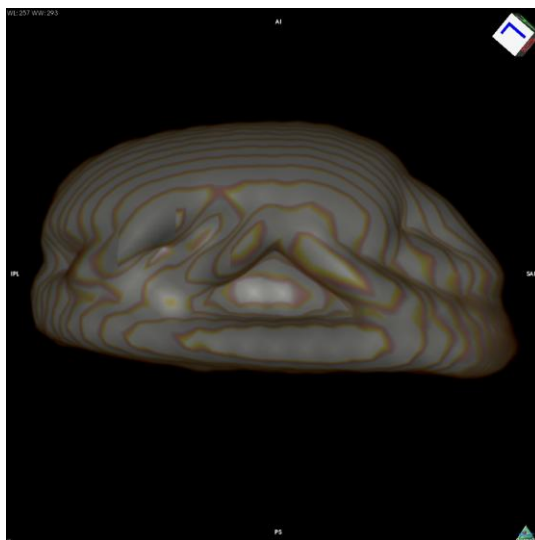
3D image of the skull showing the artificial eye, the high level of dental wear, missing upper and lower left first molars and the foreign object between the teeth.



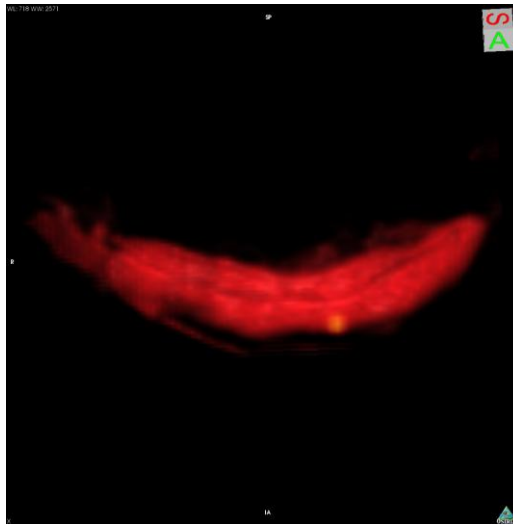
3D image showing a cross section of the skull. One molar can be seen embedded in the resin inside the cranial vault. The lower left first molar with dental caries is also visible. It is also possible to estimate the age group by assessing the degree of wear especially on the third molar which is last to erupt. According to Brothwell's classification, an age of between 35 and 45 would be associated with this level of attrition.



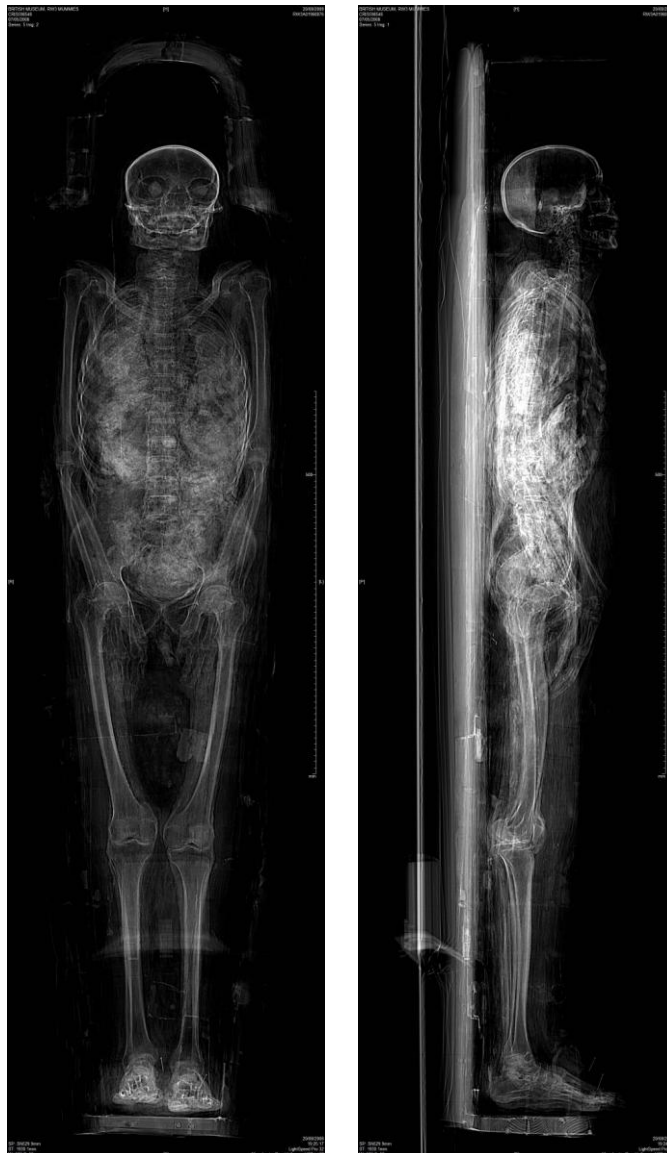
3D image of the skull and neck showing the artificial eyes and packing in the neck area.



3D image of the heart scarab that was detected in the abdominal area. Attempts made to investigate if there is any evidence of inscriptions on the base of the scarab, as commonly found in heart scarabs, were inconclusive.



3D image of the package found between the teeth.



AP and LP scout images produced during the CT examination



X-ray image of the pelvis showing the characteristic traits of a male pelvis such as the narrow subpubic angle, oval shaped obturator foramen, funnel shaped pelvic basin and a relatively large acetabulum, where the femoral head articulates.



Lateral view (X-ray) of the skull showing the line marking the level of the resin inside the skull. This indicates that the mummy was placed horizontally following the excerebration process and pouring molten resin inside the skull.

Cat. No. 2: Mummy inside cartonnage case of *Pef-tauemawy-khonsw*:

Museum Inventory Number: EA 6681 (mummy inside cartonnage case)

Acquisition: Not recorded

Associated objects: None

Provenance: Thebes¹²⁷ (Budge 1898:31)

Date: 25th Dynasty (Taylor 2009b:Pl:I,3)

Dimensions:Cartonnage: Length:169cm (Dawson & Gray 1968:11),
Length= 171.8cm (measurement taken from scout AP CT image,
Length 172cm (from scout LP CT image).
Thickness (average) of cartonnage:0.8cm
Cartonnage maximum width:48.28cm (Measurement from scout AP CT image).

Mummy with wrappings:Length 164.4cm (from AP scout), 164.4 (from LP scout)
Maximum width 46.3cm (from AP scout).

Mummy without wrappings:The height on the lateral scout = 161.72cm from head to inferior heel skin; 159.73cm from head to inferior margin of calcaneus).

Bibliography:

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- Taylor, J. H. (2001) Taylor, J.H. (2001a) *Death and Afterlife in Ancient Egypt*. London:The British Museum Press:247. (for the foot board).
- Taylor, J.H. (2009b) Coffins as Evidence for a 'North-South divide' in the 22nd-25th Dynasties. In G.P.F. Broekman, R.J. Demarée and O.E. Kaper (eds.) *The Libyan Period in Egypt, Historical and Cultural Studies into the 21st– 24th Dynasties:Proceedings of a Conference at Leiden University, 25-27 October 2007*:375-415. Leiden:Peeters Leuven.Pl:I,3.

Radiological analysis: May 2008, conventional X-rays, AP and lateral views, spiral CT scan. A total of 12 X-ray images were produced during the examination of this mummy:skull 4, thorax 2, abdomen 2 and limbs 4. The total number of the CT Axial images is 2777 in addition to frontal and lateral scan projection radiographs (scout views).

Physical anthropological data:

Sex: Male

¹²⁷ (For further information of Theban cartonnage case, see Taylor 2009b)

Age:20-25 years old (young adult)

Stature:

Femoral length = 41.79cm.

Stature:158.24cm \pm 3.218

Tibial length = 35.51cm

Stature:159.90 cm \pm 3.002

Mean stature:159 cm.

Exterior description:The cartonnage case is decorated in accordance with the style used during the late 22nd Dynasty or early 25th Dynasty. *Payeftjauemawykhons* is represented wearing a striped blue and yellow wig. Remains on the wig suggest that the ears were represented but are now missing. A mark under the chin also suggests that a false beard was once attached to the face. A black scarab is depicted on the top of the head. A brightly coloured wide collar is depicted on the chest. Below the collar, on the chest, there is a depiction of the solar ram-headed winged falcon representing Horus. The Four Sons of Horus are represented in two pairs on each side of the ram-headed falcon. Below the ram-headed falcon, there is another representation of a falcon stretching its wings over the abdomen of the deceased and standing on the fetish of Abydos; that is depicted in the centre of the case and dividing it into two symmetrical sides, and extending from the abdomen towards the feet. A number of deities are represented on the case on both sides of the fetish of Abydos such as winged falcons, Anubis, Selkis and Neith. A symmetrical scene over the foot area of the case represents Wepwawet as a jackal with burning incense. The signs *Ankh*, *Neb* and *Was* are repeated on the foot area of the cartonnage. A foot board was originally attached to the foot area but has been separated from the cartonnage case. A scene represents the Apis bull which, characterised by distinctive markings and standing on the hieroglyphic sign of the foreign land, is depicted on the wooden board. The bull is wearing a large collar with a counterpoise. The name of the deity, Ptah, is also inscribed above the bull, demonstrating the association of the Apis bull with the Temple of Ptah at Memphis (Taylor 2001a:248).

Radiological description:

General condition: poor with post-mortem disarticulation of several areas of the skeleton.

Cartonnage Case: It is clear from the scout images that the mummy occupies all the available space inside the cartonnage case. The scout images (AP and LP) allow measurements of the thickness of the cartonnage to be taken at any required point.

The images also show that the thickness of the cartonnage case reached its maximum on the face area. The 3D images show that there is an additional layer of what could be plaster that supports the facial features from the inside. It may also have been a layer of the core that was left in place intentionally for the same purpose. The diagonal impact on the cartonnage case can also be seen from the axial images of the head area. The CT axial images also show damage to the bottom side of the cartonnage and loss of the outer plaster layer especially the area under the head.

Wrappings:The layers of wrappings with higher density indicate resin soaked linen. The wrappings are intact antero-laterally but defective posteriorly. The wrappings are disrupted at

the level of the thoracic inlet but are intact more inferiorly in the thorax as shown by the CT axial images. These images show that there are gaps at the back where fragments of bone, debris and soft tissue are resting directly on the modern wooden board used to support the cartonnage. The legs are wrapped together and not individually.

Skull: There is resin posteriorly in the occipital region (indicating body supine during mummification process). The X-ray images show that the pituitary fossa is intact and the ethmoid area is superimposed by the petrous bones, making it difficult to determine if the brain was removed via this route. However, the CT scans show the damaged bone in the ethmoid sinuses confirming that the brain has been removed through this approach. A few remains of broken bones and debris that probably occurred during the process of extracting the brain can be seen inside the cranial cavity. The eye globes appear to be large (3.04cm x 2.46cm). False eyes appear in the orbits; lens components are dense (HU = 1694-1872) and measure 18mm in width and 5mm in depth. Posterior to the lens is a round structure forming the false globe; this has a width of 2.75cm and a uniform attenuation of -629HU. Nasal packages have also been detected. Attenuation values of these packages range between 50 HU and 60 HU. There is probably some small amount of hair visible but no evidence of cerebral gyri. The wrappings are disrupted posteriorly.

Teeth: Teeth are present, with some mild attrition of the cusps but no evidence of abscess formation and possible caries in one of the premolar teeth. The teeth are well aligned. The right and left upper teeth are all present and in occlusion. The first molar on the lower left side is missing pre-mortem, as evidence of bone remodelling is visible from the CT images.

Neck: The cervical spine is disarticulated but there is evidence of neck packing. This has heterogeneous attenuation (- 474HU which indicates low density materials) and measures 4.2cm in sagittal diameter and 7.6cm in coronal diameter.

Spine and pelvis: The thoracic spine is completely disrupted. A few vertebrae can be seen in the thoracic cavity but most are missing, post-mortem. The left side of the pelvis has post-mortem damage. The pelvis is dislocated at the sacrum and symphysis pubis. The pelvis exhibits some traits associated with females especially regarding the shape of the ilium. The lumbar spine is completely disrupted. There are loose vertebrae (probably lumbar) seen in cross sections of the abdominal area. The trabecular pattern and density appear visually normal, excluding osteoporosis. There is a dense heterogeneous package in the pelvis and another package with a dense rim in the iliac fossa. There is post mortem dislocation of the sacrum from iliac wings.

Thorax and abdomen: The chest wall and shoulder girdles are completely disrupted. Two high density packages occupy the thoracic cavity. These packages caused the lateral X-ray projections to be of limited diagnostic value. Examination of these packages was performed using the CT axial and reformatted images in addition to 3D images. The dense material of the packages is set as if moulded by the thoracic cavities. The maximum length of the package on the left side is 35.9cm and the right side package is 35.4cm. The main component of this dense material is uniform in attenuation (52HU) with a more dense posterior peripheral rim (attenuation = 841HU). The maximum attenuation value found on the packages is 1111HU. The minimum density is -787HU which is the value for air, indicating that there are voids inside the packages. The anterior abdominal wall is disrupted in several places. The femoral heads remain articulated in acetabulae. There is no evidence of arthritis.

Extremities: The lower extremities are in much better condition than the arms. The legs and feet appear to be articulated and the soft tissue is relatively intact. The legs were packed

according to the mummification tradition of the period. The packaging material infiltrated the soft tissue as it appears in the CT images. The knees appear normal with no evidence of arthritis. There is a loose fabric package between the tibiae. The hands lie anterior to the femora and all the wrappings are intact at this level. There is hardly any soft tissue preserved on the arms which are internally rotated with elbows extended and hands pronated over thighs. The left ulna appears to be broken, likely due to post-mortem damage. There is no evidence of joint or bone disease.

Genitalia: A penis was detected confirming the sex determination.

Comments:

The mummy is in poor condition, with extensive post mortem dislocation/disruption as described. There is no obvious evidence of bone or joint disease. The brain has been removed through a trans-ethmoidal approach. Layering of resin posterior in the skull indicates that the body was supine at the time of mummification. There are false eyes in the orbital cavities and packing in the neck. Dense material forms moulds of the thoracic cage which is completely disrupted. The skin of the abdominal wall is disrupted so it is difficult to be certain how the intestines have been removed but it was probably through the left lower anterior abdominal wall in the site of the package in the left iliac fossa. There is a second dense package in the pelvis. The cartonnage case appears to be open at the back with a gap of more than 7cm in places between the sides of the slit used for placing the mummy inside the cartonnage. There is evidence of lacing still in place. The wrappings are intact around the legs and head, but disrupted posteriorly in the abdomen and extensively disrupted in the neck and thorax. The damaged wrappings allow access to the mummy which is an ideal location for further endoscopic examination of the contents of the mummy, especially the thoracic packages. This damage to the wrapping and almost exclusively to the upper part of the body corresponds with the pattern of damage caused by looters who would only target the areas where amulets were expected to be placed.



Detail of the face of the Cartonnage case of *Pef-tauemawy-khonsw*. Evidence of a beard that was once attached to the face can be seen on the chin.



Fig:Detail of the diagonal dent and the black painted scarab on the top of the head area of the cartonnage.



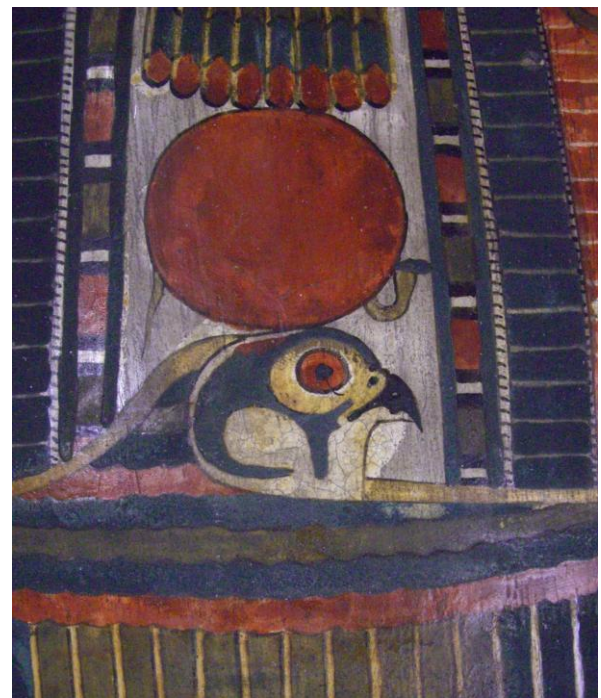
Cartonnage case of *Pef-tauemawy-khonsw*. It is not clear if the mummy inside belong to the same person as it was robbed and restored in antiquity.



Detail of the foot area of the cartonnage showing the line of inscription at the middle and the symmetrical representations of Wepwawet on his shrine with burning incense in front of him. It also shows the damage to the foot area that was restored.



Detail of the solar ram-headed falcon depicted on the chest area of the cartonnage, just below the wide multicoloured collar.



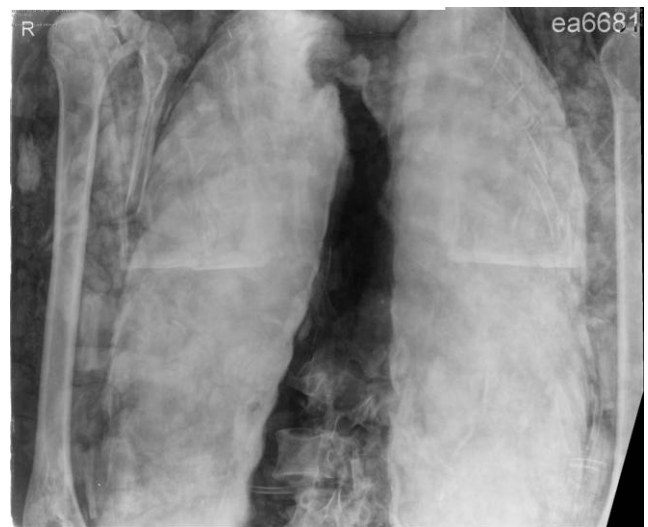
Detail of the winged falcon depicted across the abdominal area of the cartonnage.



The mummy during the preparation for the X-ray examination.



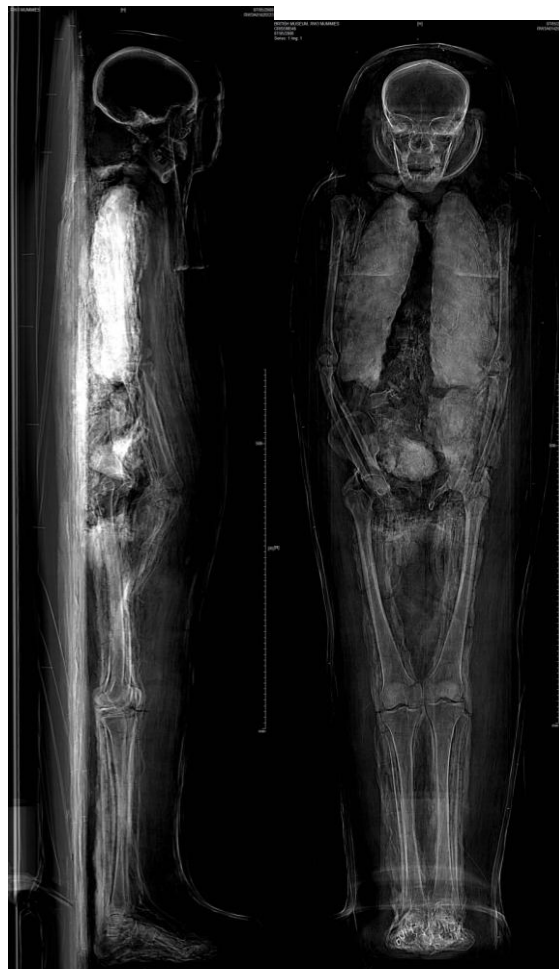
LP X-ray image of the mummy of *Pef-tauemawy-khonsu* showing the contents of the skull, the teeth and the preserved soft tissue of the nose.



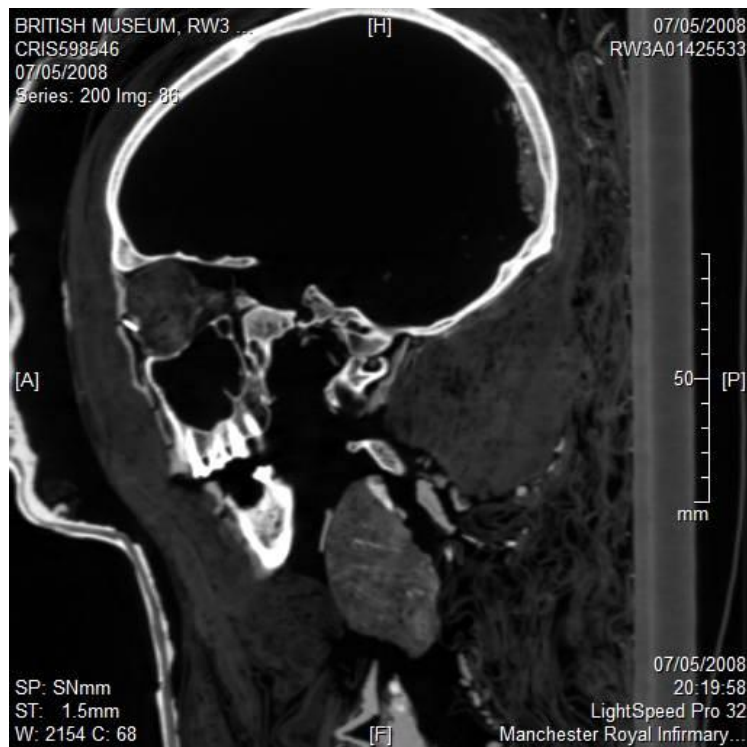
AP X-ray radiograph of the chest shows the two dense package suggested by Dawson and Gray (1968:11-12) to consist of a mixture of sand, mud and resin. A few disarticulated vertebrae can be seen as well.



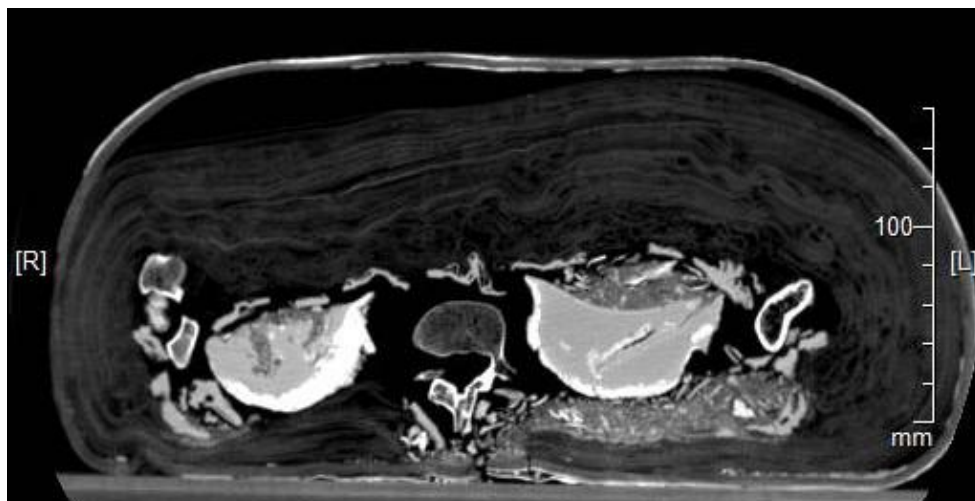
The mummy during the CT scanning examination.



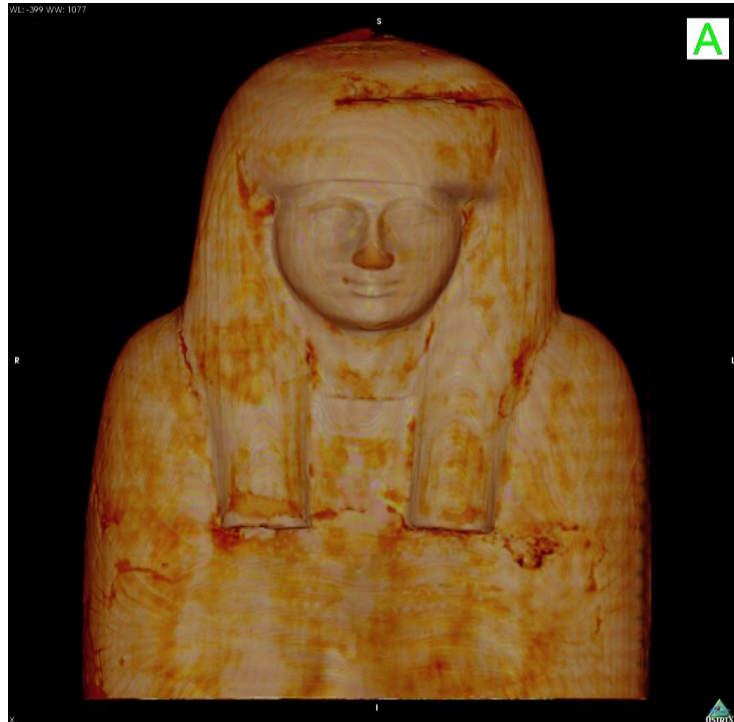
LP and AP CT scout images of the mummy showing the position of the mummy inside the cartonnage case, the dense packages in the chest and the round package in the pelvis. It is also clear that all the vertebrae are disarticulated while the lower part of the body is in a better state of preservation.



Reformatted LP image of the skull showing the missing tooth, the false eyes, the neck packing and the content of the cranial cavity.



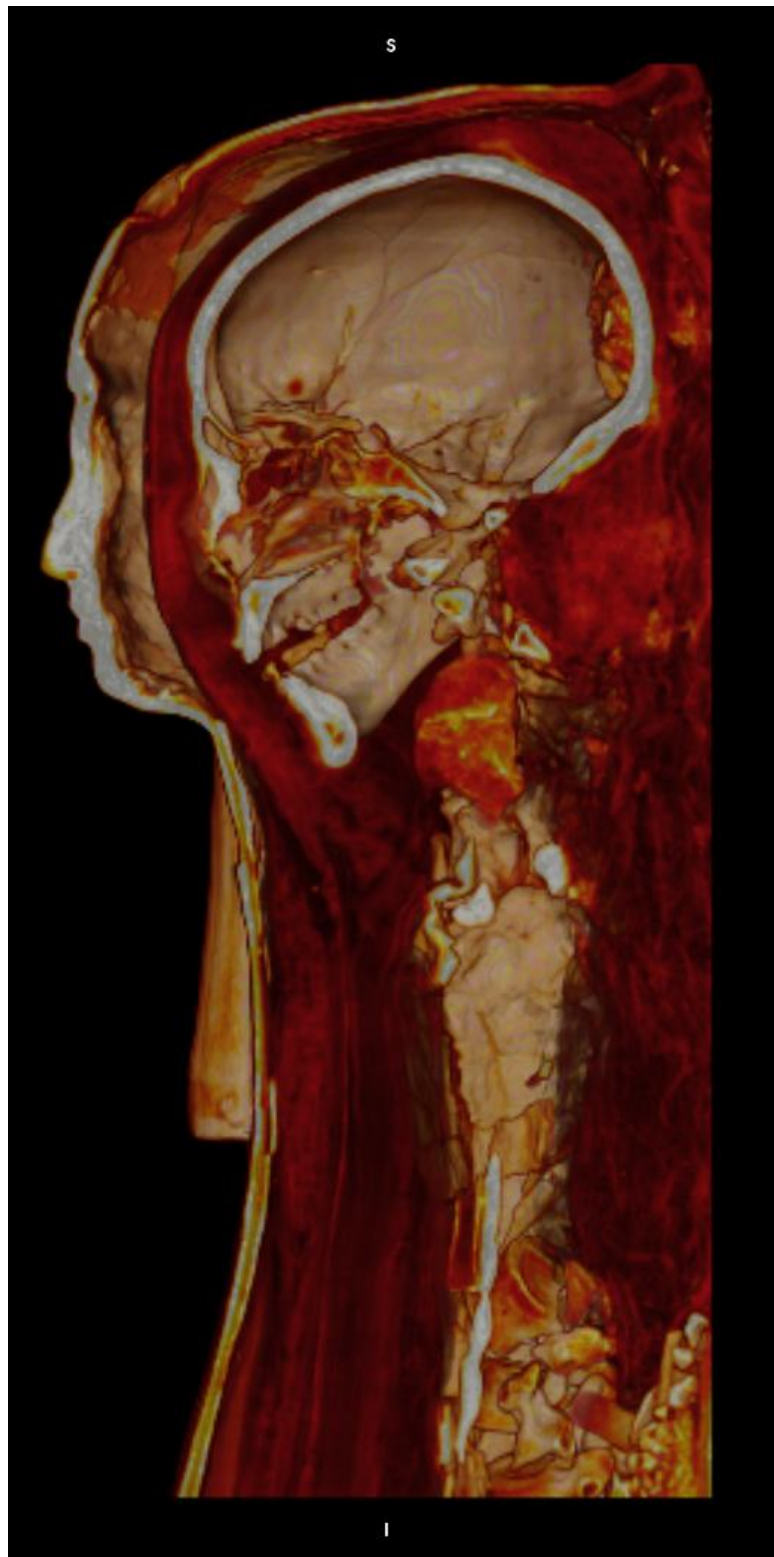
CT axial image shows a cross section of the thoracic packages and the poor state of preservation of the soft tissue. The wrappings have been damaged at the back providing access to the contents of the mummy. This gap could be used for further investigation of the thoracic packages through endoscopic examination.



3D image of the cartonnage case showing the diagonal impact damage at the top of the head area of the cartonnage.



3D image of the cartonnage showing the skull. Artificial eyes are also visible.



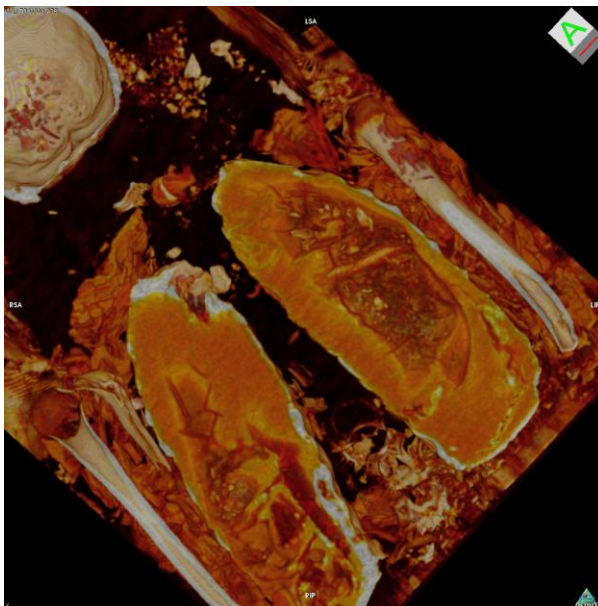
3D image of a cross section of the cartonnage case (LP) and the mummy inside showing the content of the cranial cavity, the packing in the neck area, the teeth and the location of the mummy within the case itself. The image also shows that the face area of the cartonnage is thicker than the rest of the case, probably to provide some support for the details of the face. Possibly some the core material was intentionally left in place with this purpose in mind.



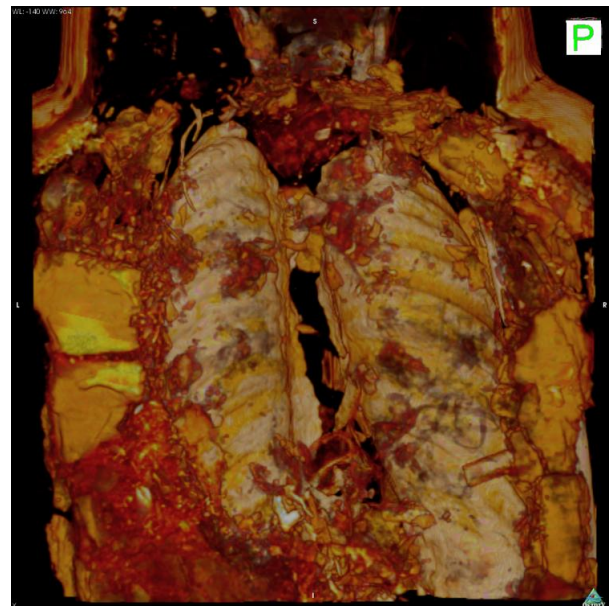
The soft tissue of the chest as it appears damaged and broken into small pieces.



3D image of the upper part of the mummy showing the surface of the dense packages inside the thoracic cavity.



The internal structure of the dense thoracic packages showing some voids. The image also show the absence of any articulated vertebrae and the general poor state of preservation of the soft tissue.



3D image showing the contents discovered towards the lower side of the packages. The posterior part of articulated ribs appear to occupy this part of the packages proving that the material of these packages was applied while the body was in a better state of preservation and while the ribs were articulated.

Cat. No. 3: Painted mummy case of Padiamunet (var. Padiamun).:

Museum Inventory Number: EA 6682.

Acquisition: Purchased from Giovanni Anastasi in 1839.

Associated objects: Wooden plain anthropoid coffin of Padiamun, (EA 6683). Three wooden coffins belong to Usermose, Padiamun's son, are part of collections in Belgium museums.

Provenance: Thebes (based on the style of the cartonnage).

Date: 25th Dynasty.

Dimensions:

- Cartonnage case: Maximum length: 176cm¹²⁸
Maximum width: 43.5cm
- Mummy with wrappings: the wrappings of the head are outside the scan field and total length of the wrapped mummy could not be measured. It was calculated from the distance between the first and last cross section axial image of wrapping to be 174.5 cm.
- Mummy without wrappings: Height: 168.5cm (from LP scout)
168.9cm (from AP scout)

Bibliography:

- Anonymous (1999) *Art and Afterlife in Ancient Egypt, Japan, 1999-2000*, exhibition catalogue, 113.
- Dawson, W.R., Gray, P.H.K. (1968) *Catalogue of Egyptian Antiquities in the British Museum I: Mummies and Human Remains*, London, The Trustees of the British Museum: 14, Pl: VIIId.
- The British Museum (1924) *Guide to the First, Second and Third Egyptian Rooms*. London: 124.
- Taylor, J. H. (2001b) Patterns of colouring on ancient Egyptian coffins from the New Kingdom to the Twenty-six Dynasty: an overview. In W.V. Davies (ed.) *Colours and Painting in Ancient Egypt*, London, The British Museum Press: 173, col. pl. 54.
- Taylor, J.H., Strudwick, N.C. (2005) *Mummies: Death and the Afterlife in Ancient Egypt. Treasures from The British Museum*, Santa Ana and London: 58-9.
- Taylor, J.H. (2009a) 'The Coffins and Mummies in the Anastasi Collection, 1857'. In D. Magee, J. Bourriau and S. Quirke (eds), *Sitting Beside Lepsius. Studies in Honour of Jaromir Malek at the Griffith Institute*: 561-579. Leuven, Paris: Walpole: 562.

Radiological analysis: August 2008. Conventional X-rays, AP and lateral views, spiral CT scan. A total of 23 X-ray images were produced during the examination of this mummy: skull

¹²⁸ This measurement cannot be confirmed from the CT scout as the scout only shows the mummy in full and not the cartonnage case. It was mentioned by Dawson in Gray (1968:14).

6, thorax 4, abdomen and pelvis 2 and limbs 11. The total number of the CT Axial images is 2969 in addition to AP and lateral scan projection radiographs (scout views).

Physical anthropological data:

Sex: male

Age: 30 to 40 years old

Stature:

Length of femur: 45.98 cm

Height: 167.2 cm (from femur)

Length of Tibia: 37.15 cm

Stature from Tibia: 164 cm

Exterior description:

The body of the case is divided horizontally into four registers. Each register is divided vertically into three compartments. The artist used black and blue pigments for the inscription and blue, red, green and black pigments for the figures on the white background. The first horizontal scene below the wide painted polychrome collar represents Padiamunet standing in adoration in front of Osiris and Isis. A simple single black line of inscription mentions the name and titles of Padiamunet. The names of the deities are visible above the figures and also appear in detailed blue letters in front of each figure. All the figures are standing under the protection of the winged solar disk. This main scene is flanked by two symmetrical representations of the Four Sons of Horus, two on each side of the main scene, which, with reference to Spell 125, confirms that Padiamunet passed successfully to the afterlife (Taylor 2003:105). There is a representation of Soker, the falcon deity, commonly used on cartonnage cases. Two compartments on each side of this scene are dedicated to vertical lines of inscriptions. Below that, a scene shows a large symbol of Abydos, the cult centre of Osiris, protected on both sides by the female deities Neith (right) and Selkis (left). Each goddess is represented with her symbol above her head and her name inscribed in front of her figure and again on vertical lines of inscription at the top of the scene. Both deities are sitting on the symbol of gold or “*nebu*” which probably represents an association with Re as “The Mountain of Gold” is one of his titles (Wilkinson 1994:171). Both deities are facing away from each other and from the centre of the cartonnage. The Abydos fetish extends to the scene below and is again protected by two standing ram-headed deities. The name “Khnum” appears in front of one of the figures. On each side of this scene, there are three vertical lines of inscription. Two symmetrical figures of the recumbent jackal, representing the deity Wepwawet, appear on both sides of the foot area of the cartonnage case. Four vertical lines of hieroglyphic inscription occupy the space between the jackal figures. Two long vertical lines of simple inscriptions run along both sides of the case between two red painted bands. Padiamunet is represented wearing a black and white striped wig and the remains of a black painted scarab appear at the top of the head.

Radiological description:

The mummy is intact inside the cartonnage case and all bones are present.

Cartonnage case:The face of the cartonnage has been moulded with more dense material anteriorly (nose and eyes; attenuation = 1231HU) and less dense material in the centre posteriorly (attenuation = 381HU). The moulded face lies anterior to the frontal bones of the skull.

The extension that was added to the foot area of the cartonnage case was essential to include the wrapped feet of the mummy. This contradicts what Dawson and Gray (1968:14) mentioned in their report as they suggested that the case was too large for the mummy which only reached the shoulder area and that the extension was not needed. It is clear from the X-rays that the mummy fills all the available space inside the cartonnage case including the extension that houses the feet.

Wrappings:There is a suggestion of a double wrapping on this section with a middle layer of increased density in the wrappings. The wrappings around the skull are dense posteriorly but loose anteriorly.

Skull:The ethmoid air cells exhibit post mortem damage that took place during the process of mummification. A little resin lies posteriorly in the skull vault. There are only few fragments of bone inside the skull, probably remains of the ethmoids. There are false eyes which were made of loose folds of fabric (attenuation = - 588HU; diameter 40mm) in the orbital cavities. There is fabric packing or wads in the nose (attenuation = - 468HU), oropharynx and in the cheeks (attenuation = - 597HU). There are small high density objects in the wrapping posteriorly which could be beads or large sand particles. A few blocks of high density material lie posteriorly in the cartonnage behind the skull, probably plaster or core material.

Neck:There is circumferential packing around the neck and evidence of the supporting rod described above that extends from the oropharynx to the chest. The wrappings are dense and contain small dense inclusions (beads or large sand particles?) posteriorly, but are loose anteriorly.

Teeth:There is malocclusion or winging which can be seen in the mandible. The right first incisor has impacted on its neighbouring teeth resulting in rotation of the right second and first left incisors. This process took place during life. The upper left third molar is missing post mortem and can be seen at the back of the mouth in the 3D image of the teeth.

Spine and pelvis:The spine is articulated. The pelvis exhibits characteristic male traits that were used to determine the sex of the mummy. There is post mortem anterior dislocation of the sacrum at the left sacro-iliac joint. The hip joints are normal. There is dense resin in the pelvis. There is evidence of a phallus which is 103.4mm in total length and is quite dense (attenuation = 321.5HU) with some surrounding loose wrappings. This confirmed the sex identification.

Thorax and abdomen:Two poles, probably used by the embalmers to support the neck and the body, were left in place. These poles only appear in the CT axial images and do not appear on the CT scout or X-ray images. In the left oropharynx, there becomes evident a supporting rod which measures 13mm in diameter and has a lower density centre (attenuation = - 514HU) and a thin, more dense rim (attenuation = - 260HU). This measures 239.8mm in length and could possibly be a reed. This support or pole is surrounded by packing 8.5 mm in diameter and the pole extends inferiorly through the left side of the neck and into the left anterior mediastinum. The length and diameter were calculated from the number of slices that the poles appeared in and this was multiplied by the thickness of each slice, 0.6mm. Another

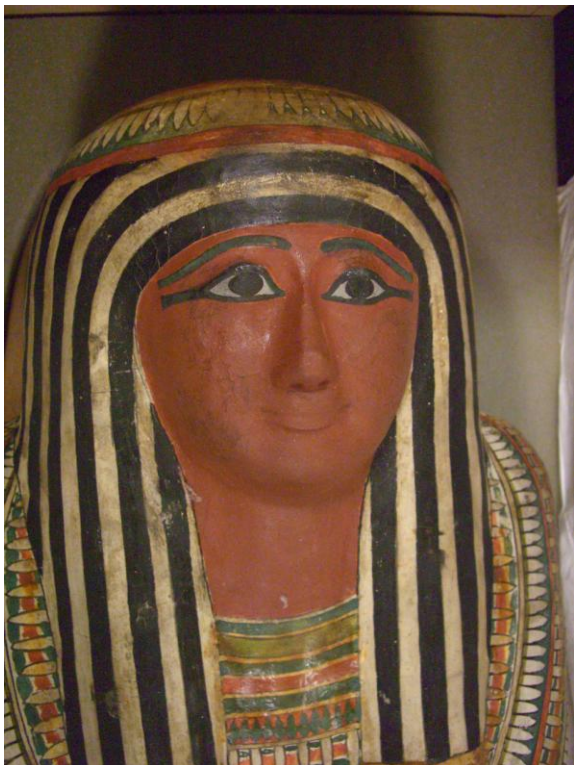
method used to confirm the measurements was to by subtract the slice location numbers where each pole appears and ends in the axial images within the mummy. Another rod that extends from the neck to the left shoulder (curved) was observed from the CT axial images. This rod is about 12.3 cm long. The diameter of the second rod is 1.6 cm. Dawson and Gray (1968:15) observed packing material in the shoulders of this mummy but the poles did not appear on the X-ray images because of their low density. There is heterogeneous resin layered posteriorly in the thoraces and detached bones (ribs and clavicle?) indicating that there is some post mortem damage to the skeleton. The supporting pole is evident in the left thorax. No definitive packages identified. The abdominal wall is not evident suggesting the abdominal cavity is open anteriorly. There is heterogeneous resin in left side of abdomen and pelvis. There are no definitive packages identified.

Extremities:It is clear from the X-rays that the hands were placed over the pubic area according to the custom of the Third Intermediate Period. There are no fractures or any signs of Harris lines in the long bones of the legs. There is loose packing between the legs. The knees appear normal. There is loose fabric packing filling the space anteriorly between the anterior wrappings of the calves and the anterior margin of the cartonnage. Neither the arms nor the legs are wrapped individually. There is a round object, possibly a bead, lying in the wrapping medial to the right thigh.

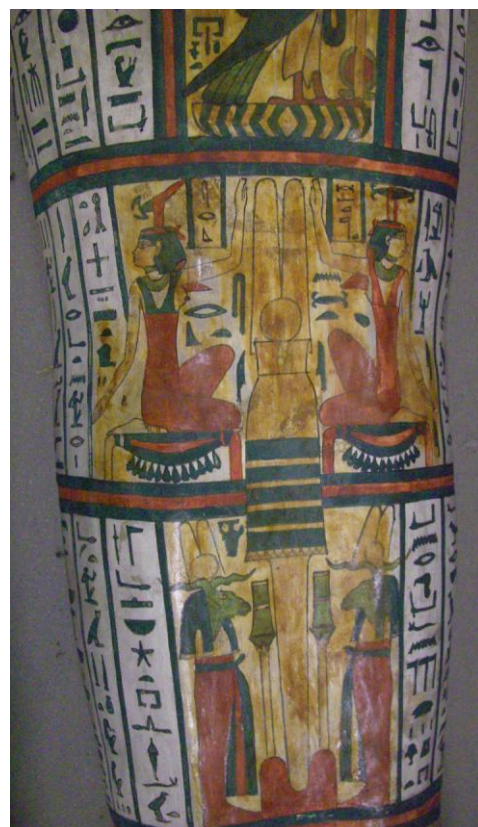
Comments:

This is the skeleton of an adult male which is generally in good condition except for some disarticulation in the chest, absence of the anterior abdominal wall and post mortem dislocation of the right sacro-iliac joint. The brain has been removed through the trans-ethmoidal approach and there are false, probably fabric, eyes. There is packing circumferentially in the neck and also packing in the nose, cheeks and oropharynx. No distinct packages are identified in the thorax or abdomen, but there is quite extensive resin layered posteriorly in these cavities. There is a suggestion of a double wrapping, and there is loose fabric packing filling the anterior gap between the mummy and the cartonnage. No evidence of significant bone or joint disease. A phallus is evident.

There is a supporting rod, probably a reed, and a cane extending from the oropharynx to the thorax and with some thin surrounding wrapping. Dawson and Gray (1968:14-15) did not mention any poles inside this mummy as they do not appear on the X-ray images. However, the CT axial images showed that the head is supported by a pole, while another curved cane extends from the head to the left shoulder. The cross section of the pole is round while the cane has a triangular cross section. The cane could be a papyrus stem as it has a triangular cross section. Other examples of poles were found in a number of mummies. Smith and Dawson (1924:124) suggested that the reason for using a supporting pole was probably due to the poor preservation of the body. They mentioned that the head would have been totally separated from the body before the embalmers inserted the pole through the foramen magnum. Smith and Jones reported a few cases of supporting poles during the Archaeological Survey in Nubia that took place in 1907-1908. There is no evidence to suggest that the head of this mummy had been separated from the body during the mummification process. The foramen magnum was not used to extract the brain as the ethmoids are damaged and the nasal route was used for excerebration. It is likely that the pole was inserted from the body through the side incision and was pushed into place. The same method would have been used for the curved cane.



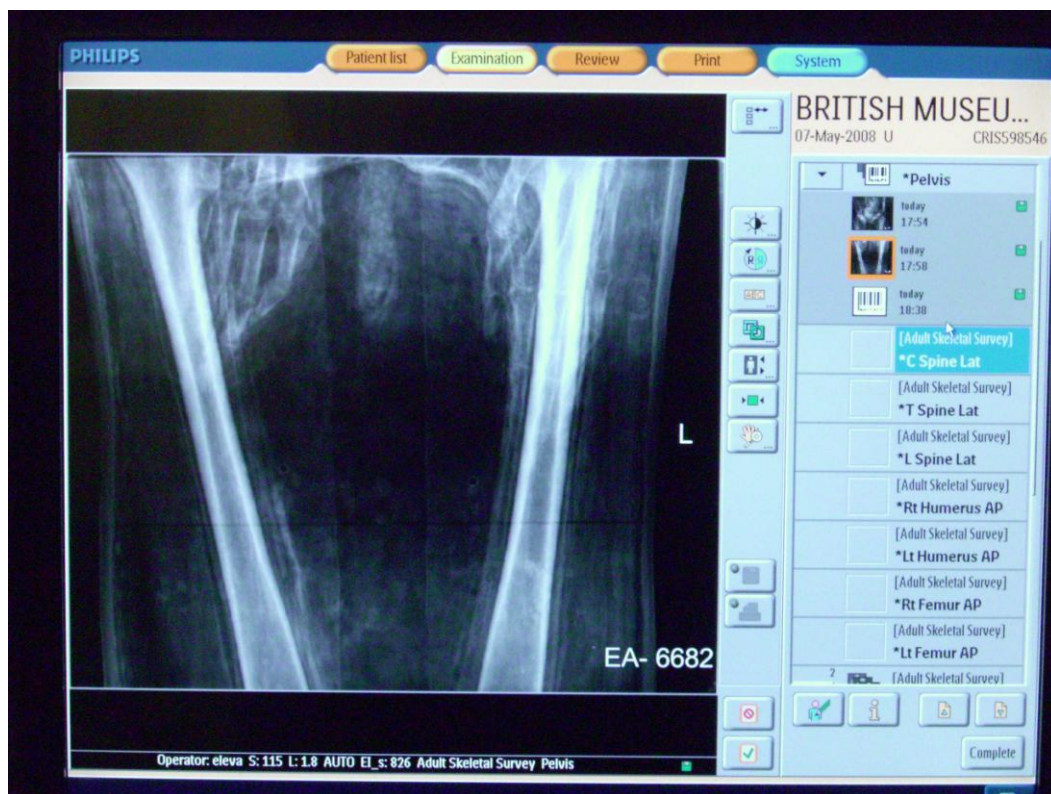
Cartonnage case of Padiamun (EA 6682).



Detail of the cartonnage case decoration which has been placed in the rectangular compartment and alternate between painted scenes and columns of inscriptions.



The cartonnage case and mummy during X-ray examination.



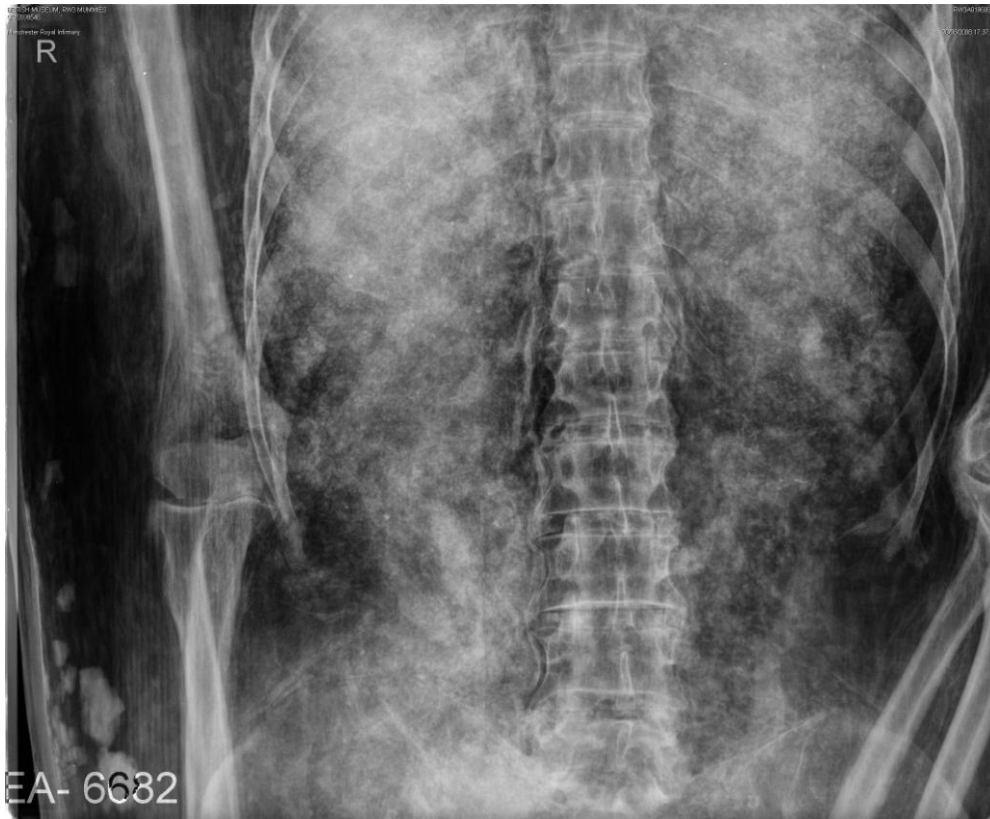
The screen attached to the X-ray developing machine instantly displays the digital radiographic image which shows, on this occasion, the hands and femora.



AP X-ray of the skull and neck showing the high density area of the face of the cartonnage case. No artificial eyes can be seen.



LP X-ray image of the skull showing the teeth and the articulated neck vertebrae.



X-ray image of the thoracic and abdominal cavity clearly showing the vertebrae in great detail which proves that CT scanning is not a substitute for conventional X-ray radiography. Both complement each other, providing more accurate and detailed observations based on both types of images.



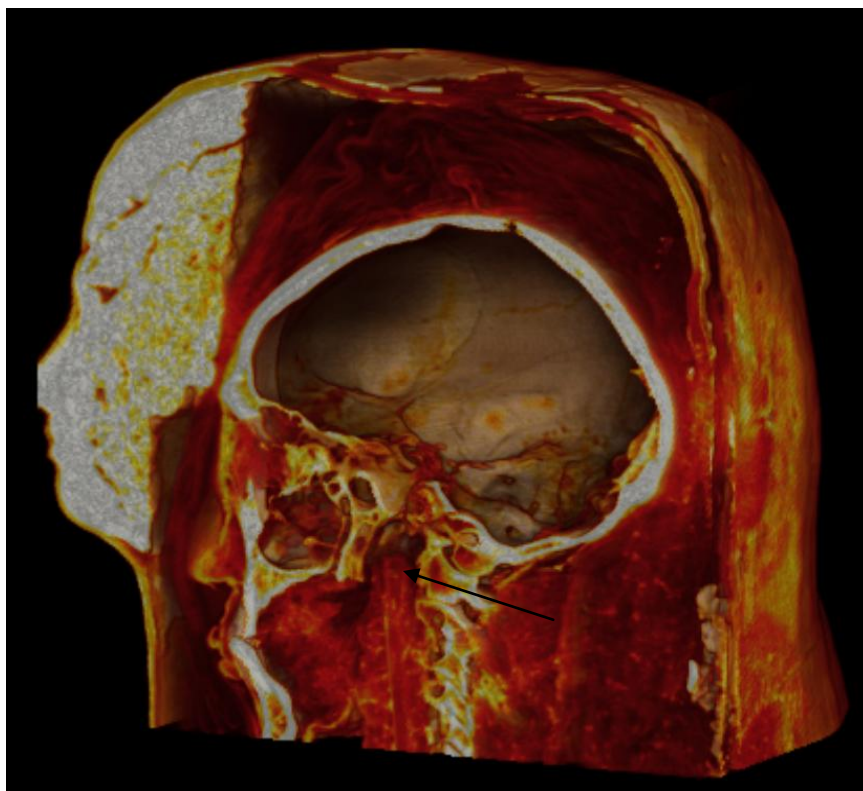
The mummy inside the cartonnage case during preparations for CT examination.



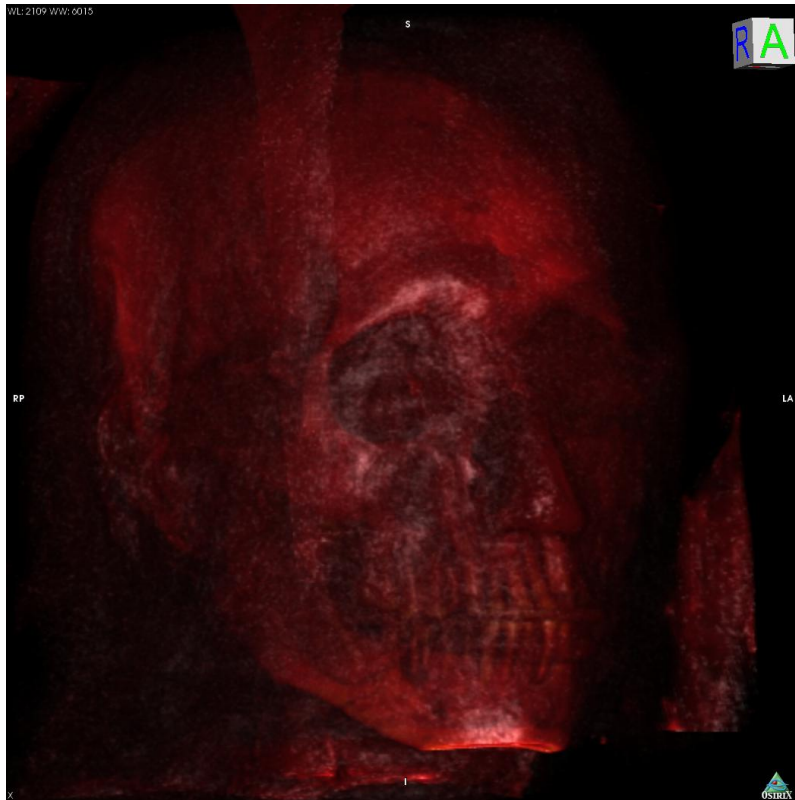
AP and LP scout Ct images of the cartonnage and the mummy of Padiamun (EA 6682).



CT axial image through the thoracic cavity showing (arrow) the pole that was used by the embalmers to support the body and was left in place. This feature was reported from other mummies belong to the same period and later.



3D image of the skull and the head area of the cartonnage showing the location of the head in relation to the cartonnage and the internal part of the face area of the cartonnage that had been filled with possibly plaster or part of the original core intentionally left in the area to provide support for the detailed facial features. The image also shows the pole that was used by the embalmers to support the head.



3D image of the face showing the well preserved soft tissue which gives an excellent lifelike image of the face of the mummy. The shape of the nose can be clearly seen in this image.



3D image of the skull which provides a wide range of information, especially regarding the teeth, such as the missing upper left missing second incisor and the two misplaced molars at the back of the mouth.

Cat. No. 4:Mummy inside cartonnage case of Tjayasetimu:

Museum Inventory Number:EA 20744

Acquisition:The mummy was acquired in 1888

Associated objects: None

Provenance:Thebes, Deir El Bahari but exhibits some Northern characteristics.

Date:22nd Dynasty

Dimensions:

- Cartonnage case:Maximum length:150.6cm (from AP CT scout)
(151 according to the BM online Database)
- Maximum width of cartonnage:35.9cm (from AP scout)
- Mummy with wrappings:Height: 129.6 cm (from AP Scout)
- Mummy with wrappings:Width:27.7cm (from AP scout)
- Mummy without wrappings:Height:126.5 cm (from AP scout)
Height:125.6 cm (from LP scout)

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Radiological analysis:Conventional X-ray Radiography and multi detector CT scanning were used to examine the mummy in August 2008. A total of 17 X-ray images (skull 6, thorax 2, abdomen and pelvis 3 and legs 6) were produced during this study in AP and LP positions. The total number of the CT axial images produced is 2443 in addition to the AP and Lateral scan projection radiographs, the reformats and the 3D images.

Physical Anthropological Data:

Sex:Female

Age:Dental age 7 to 8 years old. Skeletal age, based on the fusion of epiphysis, is between 10 and 13 years old. Mean age:12 years old.

Stature:

Maximum length of right femur = 34.15cm

Maximum length of left femur = 34.51cm

Right tibia: 28.26 cm

Stature: not assessed (the standards are for adults)

Exterior Description:

Tjayasetimu is represented on the cartonnage case with her right arm flexed on her chest and her left arm extended along the side of her body. The attached wooden lower right arm and left hand are unusual features that characterise this case (Taylor 2010:89). A vertical line of inscription, the *Htp di nsw* formula, runs down the middle of the cartonnage, dividing it symmetrically just below the abdomen. The wooden right arm was painted red and decorated with a black bracelet around the wrist. The cartonnage case was covered with dark coating including the gilded face, the vertical line of inscription and the modelled feet (Dawson & Gray 1969:19). No dark material is visible on the sculptured wooden right arm, as the photograph of the mummy published in Dawson and Gray (1969:Pl X) shows. It is clear that sometime after Dawson and Gray's catalogue was published, cleaning took place to remove the dark resinous layer from the gilded face, the central line of inscription and the modelled feet.

Dawson and Gray (1969:19) suggested that the case was made for an adult female while the mummy belongs to a girl, about twelve years old. They also noted the dark coating and suggested that it is black resin which would have been poured as a liquid over the painted case. The remains of the dark resinous material on the surface of the cartonnage case, particularly around the perforation for the wooden right arm, indicates that the liquid resin was applied first, and then the embalmers cut out an area big enough for the wooden arm to be attached. The same process was probably also used with regard to the wooden left hand which suggests that, during the manufacturing of this case, the core had to be modelled with the posture and wooden attachments in mind.

Some details of the painting can be seen underneath the coating and in areas free from it. It is clear that the figures were painted on a white background which represents a dress that terminates just above the modelled feet. The deceased is represented wearing a blue wig and the face is gilded. A wide collar covers the top of the shoulders and the modelled breasts are covered with rosettes. Winged figures cover the upper arms, and four figures, probably the Four Sons of Horus, are represented on the abdomen, just below the left arm, two on each side. There is also a depression on the surface of the cartonnage to represent the navel. The line of inscription is surrounded by symmetrical winged figures; one of them appears to be a winged standing figure of Nephthys wearing a long garment which is visible above the right lower leg. Two red lines run along the edge on each side of the vertical back slit. The same feature can be seen in the cartonnage case of Djedamenufankh (EA 29577).

Taylor (2009:398) points out that the phrase "water to the ba" was usually found in northern coffins while this coffin was found at Thebes. There are other examples of purely northern features that can be seen on coffins from the south such as the decoration on the hand which is called "gloves" and the representation of the jackal above the central vertical line of inscription which usually contain the *Htp di nsw* formula (Taylor 2009b:398).

This indicates that some northern features and styles were used in Thebes and other southern provenances.

Radiological Description:

Cartonnage case:The CT images provide valuable information regarding the manufacturing techniques of the cartonnage case. The CT images clearly show a number of tree rings which confirms that the gilded face of the cartonnage is made of wood (attenuation = -480). Future research could explore the possibility of a dendrochronological study to determine the age of the wood. The CT images also show that the wooden face has been attached directly to the glued layers of linen before the layer of plaster was applied to the case. High density, probably stone, eyes (attenuation = 1520) were inserted in the wooden face.

The images also show a number of internal cracks. This information is important for conservation purposes. There is no evidence of any lacing at the back of the cartonnage case. It is clear from the images how the wooden foot board was attached to the cartonnage by means of wooden dowels.

Wrappings:There are multiple tiny high density areas within the wrappings which may suggest the presence of beads between layers of the wrappings. The wrappings are intact and there is a loose fabric package adjacent to the left anterior chest wall.

Skull:AP, AP with 30⁰ caudal tilt, AP with 60⁰ caudal tilt, and lateral projections were produced in order to view the skull which is situated in the shoulder area of the cartonnage. The cranial vault is empty apart from some debris which is probably some bone fragments. The ears and the nose are well preserved. The foramen magna appear wider than normal which indicate that the brain may have been extracted through an incision at the back of the head. However, the CT images do not provide clear evidence of an incision at this location. pituitary fossa appears intact. There is no defect apparent in ethmoid air cells which confirms that the brain was not removed by this route. Faint densities in the orbits suggest false eyes being present. Around the skull vault there is definite evidence of hair. There are triangles of soft tissue within the orbital cavities tethered at the orbital apex and at lateral margins of orbits (desiccated native orbital tissue?) with irregular dense areas (artificial material) in the region of the native lenses. The spheno-occipital synchondrosis is well seen and completely open, suggesting the subject is under 10 years of age. Un-erupted upper molar teeth are visible. Packing is evident in oropharynx. There is a little resin layered posteriorly in the skull vault indicating body supine during mummification process. Around the mandible and neck area there appear to be braids and beads.

Teeth:There are many un-erupted teeth present so the majority of milk teeth still in place, and which appear to be in good condition. The right and left sides of the upper and lower teeth are identical. A description is given here of the right side.

Maxilla: The crowns of the first and second molars are about to complete formation. The root of the first molar is almost complete. The first and second deciduous molars are in occlusion. The crown of the upper right premolar is completely formed. The upper canine is in crypt and its crown has completely formed which indicates that the root has started to form. The second upper incisor is about to erupt with the root half formed and the first incisor is erupting with $\frac{3}{4}$ of the root formed.

Mandible:The second molar is in crypt and its crown is almost complete. The first molar is present and $\frac{3}{4}$ of the root is formed. The deciduous first and second molars are in occlusion. The premolar is rotated in its crypt with the crown nearly complete. The deciduous canine is in occlusion while the root of the permanent canine has started to form. The permanent first

and second incisors are erupting with their roots $\frac{3}{4}$ formed. The first and second molars indicate an age of about 7 to 8 years old.

Spine and pelvis: In the pelvis, there are heterogeneous resin collections and mild post-mortem anterior subluxation of the sacrum from the ilia. No package is identified in the pelvis.

Thorax and abdomen: The cervical and thoracic spine are intact, as are the thorax and upper arms. The thoraces are radiolucent so largely filled with air. No obvious packages can be visualised. At the level of the shoulders of the skeleton on the anterior surface of the cartonnage, there is a hand made out of wood. From the shape and the position of the index finger which points to the left and is in the pronated position, this would appear to be mirroring a left hand. At the shoulders of the skeleton the joints appear normal. Only a little resin is present layered posteriorly in the thoraces, more on the left, indicating that the body was in the supine position during the mummification process. Some structures are present between the anterior ends of the clavicles and the anterior margin of the thoracic vertebral bodies. There are some structures that appear in the body cavity that could possibly be the remains of a trachea.

In the lower thorax and upper abdomen, there is more dense resin layered posteriorly, again more extensive on the left side, but there are also high density structures draped either side of the thoracic spine, and a large anterior structure which appears to have a central cavity or structures (may be heart or liver). More inferiorly there is more resin posteriorly on the right. The abdominal organs/intestines have been removed through the left abdominal wall where there is a defect in the abdominal wall in which there is a pack of loose fabric. This incision is less than 10 cm long.

The pronated forearms lie anterior to the abdominal wall at the level of the anterior superior iliac spine of the ilia. Growth plates are evident in the femoral heads which are normally articulated within the acetabulae. In the perineum, there appears to be two orifices (vagina anteriorly and rectum posteriorly) suggesting the skeleton is that of a girl.

Extremities: The long bones are in a good state and intact. There is evidence of open growth plates confirming the skeleton of a child. The arms are not wrapped separately from the thorax. There is no evidence of joint or bone disease and no obvious packages between the legs but there is loose fabric packing between the thighs. The joints of the knee appear normal. The legs are wrapped together, not individually, and beads are evident between the layers of wrappings. There are prominent Harris growth arrest lines in the distal tibiae indicating illness or some other cause of interruption of enchondral ossification at that time of skeletal development. The feet of the cartonnage have been fashioned out of wood. The original feet are intact with evidence of open growth plates.

Comments:

The mummy is that of a child, probably a girl less than 10 years of age. The skeleton is in excellent condition and apart from minor post mortem anterior subluxation at the sacro-iliac joints, is intact. There is no evidence of joint disease but prominent Harris growth arrest lines in the distal tibiae indicate an episode of illness or other event which interrupted skeletal development. The wrappings are in good condition and also intact, with evidence of beads between the wrappings. The brain has not been removed through the trans-sphenoidal

approach. There is a pack in the oropharynx. The thorax is empty apart from some resin layered posteriorly. The abdominal contents have been removed through the lower left abdomen where there is a loose fabric package. There is dense resin in the posterior abdomen and pelvis and some structures which may be organs (heart or liver?). The cartonnage is in good condition with the face, a hand and the feet created out of wood. The face is gilded with dense material included for the eyes.



Cartonnage case of Tjayasetimu. The right wooden hand was not transported with the mummy for examination.



The cartonnage case of Tjayasetimu. The painted scenes have been covered with black black resinous material. Modelled feet were attached to the foot area of the cartonnage.



The mummy of Tjayasetimu during the X-ray examination.



LP X-ray image of the skull and upper thorax.



X-ray image of the skull showing the unerupted teeth which was used to estimate the age at death.



AP X-ray image of the feet showing the wooden modelled feet of the cartonnage case as well as the original feet of the mummy.

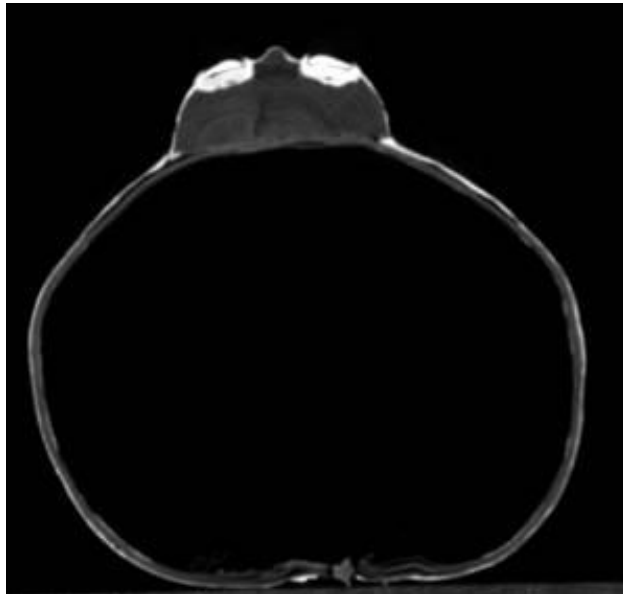
AP X-ray image of the lower legs showing lines of arrested growth on distal and proximal sides of the long bones.



The cartonnage case and mummy of Tjayasetimu during CT examination



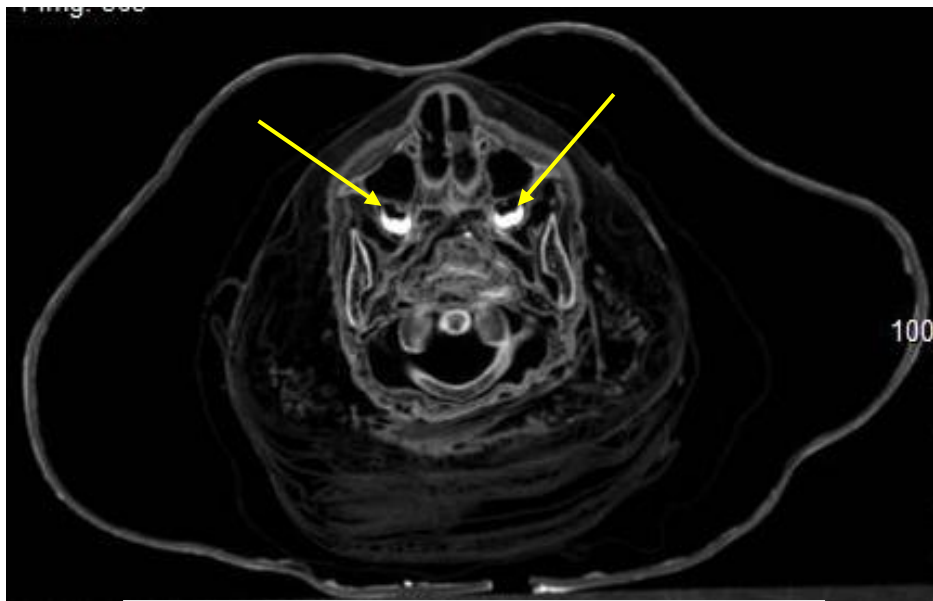
AP and LP Scout CT images of the mummy. The substantial difference in size between and the mummy and its cartonnage case suggests that it might have been made for another individual.



CT axial image showing the wooden face attached to the cartonnage and the inlaid false eyes



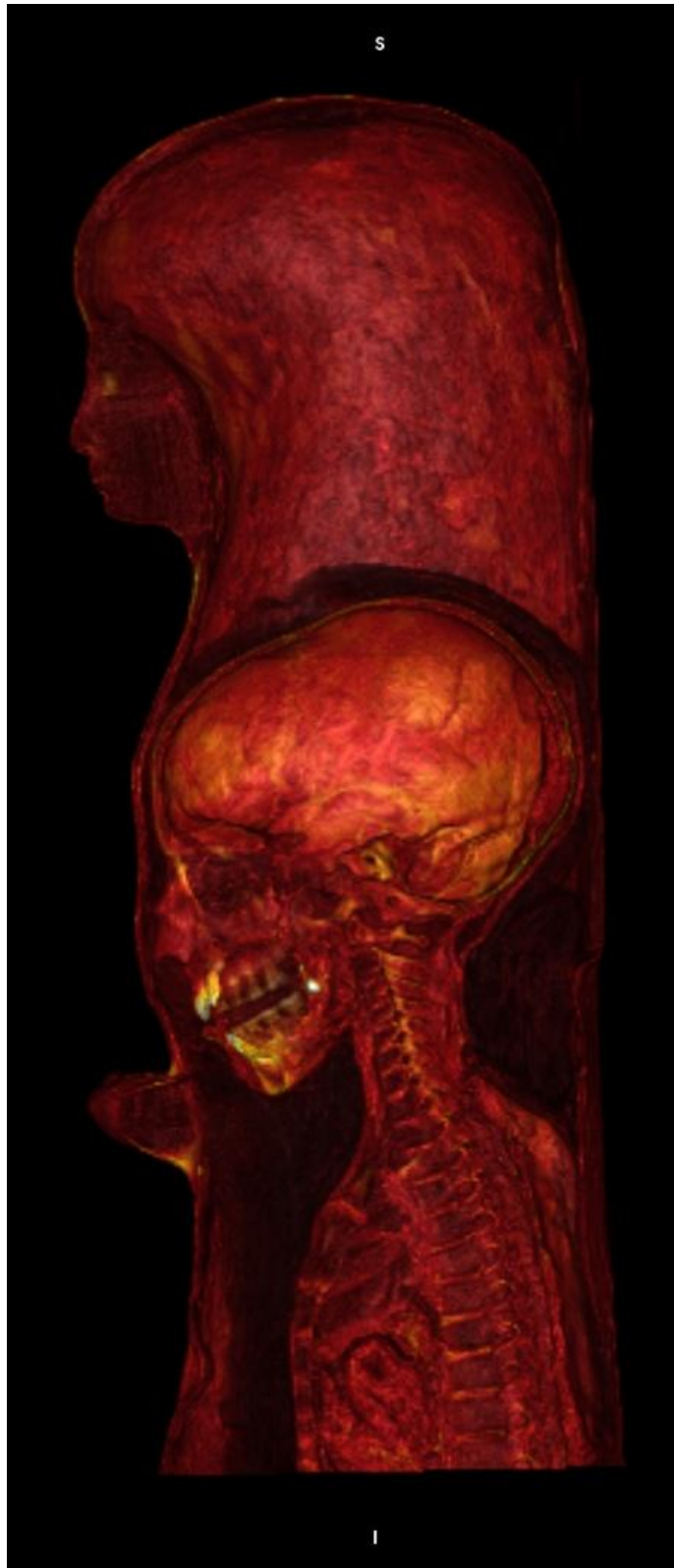
CT axial image of the skull showing the intact ethmoids indicating that the brain was not extracted through the nasal route. As the cranial vault appears empty, the brain must have been extracted through a different route, probably through the foremen magnum. The ears also appear intact and well preserved.



CT axial image showing unerupted upper molars.



CT axial image showing the perineum. This image supports the sex identification as a female.



3D image of the wrapped mummy inside the cartonnage case showing the skull, the neck and the upper thorax. The teeth can be seen clearly from this view.



3D image of the upper part of the cartonnage case showing the skull and upper thorax.



3D image of the mummy showing the modelled feet and their location compared to the original feet inside the cartonnage case. The cross section of the modelled wooden feet shows the tree rings, confirming the identification of their material.

Cat. No. 5:Mummy inside cartonnage Tjentmutengebtu:

Museum Inventory Number:EA22939

Acquisition:Purchased from Raymond Sabatier in 1890

Associated objects:none

Provenance:Thebes

Date:Early 22nd Dynasty

Dimensions:

Cartonnage case:

- Maximum height:170cm (from AP & LP scout images), 169 cm (from BM database).
- Width of the cartonnage:46.8cm

Mummy:

- Mummy with wrappings:157 cm (from AP & LP scout images),
- Mummy without wrappings:154 cm (from AP & LP scout images)

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Radiological analysis:

Conventional X-ray Radiography and multi detector CT scanning were used to examine the mummy on 7th May 2008. A total of 16 X-ray images were obtained (skull 4, neck 3, thorax 2, pelvis 2, limbs 5) and a total of 2773 slice images were produced during the CT examination. This is in addition to the AP and lateral projection scout views, the reformats and 3D images.

Physical anthropological data:

Sex:Female (shape of pelvis)

Age:20-30 years old.

Stature:

Maximum length of the left femur:43.8cm
Height:159.4cm±2.517
Maximum length of the right femur:43.4cm
Height:158.5cm±2.517
Mean height:158.9 cm
Maximum height of left tibia:35.8cm
Height:157cm±1.921cm

Exterior description:

The cartonnage case is brightly painted with different polychrome scenes following the southern style that was used in Thebes during this period (Taylor 2009b:378). The scenes were painted on a grey background. The wig is represented in blue and decorated with yellow dots. An elaborate vulture headdress with two pairs of wings on each side is depicted above the wig. A winged scarab and the ba bird are represented on the neck and between the lappets of the wig. The deceased is represented wearing a wide polychrome collar that covers a large area of the chest. The cartonnage case is divided below the collar into horizontal compartments that have been filled with elaborate scenes. The first compartment below the wide collar depicts the deceased led by Horus who presents her to Osiris. It is interesting to note that the scenes extend horizontally to cover all the visible area of the cartonnage including the sides of the case. The line that divides the front and the back of the case lay at a much lower point, providing a much wider area for each scene.

Radiological description:

Cartonnage case:There is evidence of lacing still in place. The thickness of the cartonnage is about 1cm. The front is less thick than the sides and the back. Remains of plaster or the core material used during the manufacturing of the cartonnage case can still be seen behind the face area. The moulded face of the cartonnage has dense eyes (attenuation = 1613HU). The small moulded nose has an attenuation of 628HU.

Wrappings:The wrappings are damaged at the face area, near the nose. Extra wrapping were observed under the skull, probably provided to fill the gap at the back of the neck. The layers of the wrapping exhibit a number of high density layers in the cross section of the wrappings which indicates that resin was used to seal the layers of wrapping before adding more layers. The resin was only applied to the top of the mummy. The layers at the back did not show a high density layer of wrapping.

Skull:Straight AP X-ray radiographs were difficult to obtain as the head is slightly rotated to the right inside the cartonnage. There is evidence of matted hair beneath the intact wrappings. On some sections through the upper skull vault, the diploic space is widened suggesting that this individual may have had anaemia with marrow hyperplasia. There are radiodense false eyes in the orbital cavities, lying anterior to the triangular areas (with apex pointing posteriorly) of desiccated native orbital tissue. The false eyes are oval in shape and are made up of three layers; posteriorly an area of attenuation 473.5 HU, then two more anterior and dense sections corresponding to the lens of the native eye. These each measure approximately

3mm in depth and measure 27.2mm in width and have an attenuation of 2081.5HU in the anterior component and 1559HU in the middle component.

The ethmoid bones are absent indicating that the brain was removed through the transphenoidal approach. There is a fabric nasal pack (attenuation = -541HU) filling the area of the absent ethmoid air cells, with evidence of damage to the left lacrimal bone allowing the pack to bulge into the medial aspect of the left orbit. This fabric pack unravels and extends into the cranial cavity. These features confirm that the brain was removed through the trans-ethmoidal approach and then the tract was packed with fabric. No evidence of brain tissue inside the cranial vault.

The mouth is open. There is a heterogeneous, irregular pack in the mouth and oropharynx (attenuation = 249HU) which measures approximately 62mm in maximum sagittal diameter and 54mm in coronal diameter. The ears are preserved.

Neck:The neck has been packed and a large dense metallic amulet with wings was placed over the neck. The anterior heterogeneous neck pack which has an AP diameter of 36mm and attenuation of -54HU extends down to the level of the thoracic inlet. The metallic neck amulet lies anterior to this pack and is curved around it. The attenuation of the amulet is measured as 3071HU which is the maximum measureable on CT, which probably indicates that it is gold. Fabric wrappings which lie anterior to the amulet are in good condition. There are probably three layers of wrappings separated by two slightly more dense layers which extend down into the thorax. The inner most layers are more loosely wrapped than the outer layers. There is a posterior dislocation of the cranium from the first segment (C1 atlas) of the cervical spine.

Teeth:All the upper teeth are present. All incisors are present in the mandible. The teeth exhibit healthy roots as attested from the CT reformatted images. There is a substantial degree of attrition of the cusps. The first and second molars have no enamel. The third molar has just one ring of enamel but almost has no crown.

Spine and pelvis:There are two packages in the left pelvis. A dense metallic plate overlies the left side of abdomen which presumably covers the abdominal wall defect through which the abdominal contents were removed. Two metallic amulets lie on the abdomen superior to sacrum (small amulet) and mid groin (larger amulet). There is a little post-mortem anterior subluxation of the sacro-iliac joints which otherwise appear normal, as do the hip joints. There is another dense metallic ornament anterior to the symphysis pubis (section 1385). The arms and hands are pronated over the groin.

Thorax and abdomen:There is a dense metallic amulet in the shape of a bird laid on the middle of the anterior chest wall. There is heterogeneous resin layered bilaterally posteriorly in the thorax. There is a thin metal plate adjacent to the posterior margin of the left arm; width = 38.1mm; thickness = 3mm, attenuation = 2365.5HU. There are some linear tubular structures in the right side of the chest which could be part of an organ (maybe resin filled bowel or myocardium). There is other structure anterior to the thoracic spine which could also be parts of disrupted organs (liver?). In the right hemi thorax, there is a round structure which contains seven irregularly faceted structures (attenuation = 85HU; size approximately 15.3mm) with central radiating low attenuation areas (Mercedes Benz sign?) which resemble gall stones.

There is a metallic amulet of the middle of the anterior chest wall which is 9.8mm thick and has an attenuation of 230.2HU with a wide SD of 797. The attenuation of the round emulate below is 2066.5HU, and is 19,6mm in width and 10.8mm in depth.

There are several dense packages in the hemithoraces. There is dense heterogeneous resin/package in the right hypochondrium and abdomen. There is a package in the left hypochondrium

In the right hypochondrium, there are two heterogeneous packages, and loose wrappings lie anterior to the thoracic spine, in the epigastrium. There is a defect in the left lower abdominal wall confirming that this is the site through which the abdominal contents have been removed. Over the skin defect, there are two overlapping dense plates. The more denser one has an attenuation of 2454HU. Beneath the metallic plates, there is much loose fabric packing, which extends into the pelvis. There is a small dense metallic ornament lying in the midline on the anterior abdominal wall. The three layers of the wrappings are intact

Extremities: The arms are wrapped with the body and not separately. There are plaques of dense resin around the legs. There is no evidence of joint or bone disease. There is no evidence of Harris growth arrest lines.

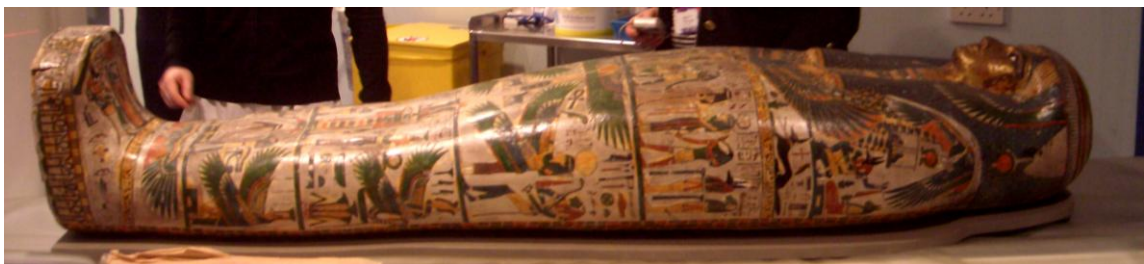
Comments:

The skeleton is that of an adult, probably female from the ovoid shape of the pelvis. The condition is good with full articulation of the skeletal parts except at the cranio-cervical junction and mild post-mortem anterior subluxation of the sacrum at the sacro-iliac joints.

There is no evidence of bone or joint disease, except for increase in the diploic space suggesting anaemia and marrow hyperplasia. The brain has been removed through the trans-ethmoidal approach and the track made has been filled with fabric which has unravelled posteriorly into the cranial cavity. The abdominal contents have been removed through the left lower anterior abdominal approach. There are false eyes and an oropharyngeal and neck packs. There are two packages in the left side of the chest and abdomen, some structures which could be part of decomposed/desiccated chest or abdominal organs and possible gall stones on the right. The wrappings are intact and there is a suggestion that there are three layers of wrappings. No individual wrappings of the arms and legs. There is loose fabric packing in the lower abdomen and pelvis. Ten dense amulets are in place (neck, chest [2], abdomen [4], groin, and left arm, feet); some have a very high attenuation suggesting they may be gold. A heart scarab was placed on the abdominal wall under the winged falcon. 3D images and rotations of the scarab aiming to determine if the surface of the scarab is inscribed proved inconclusive.



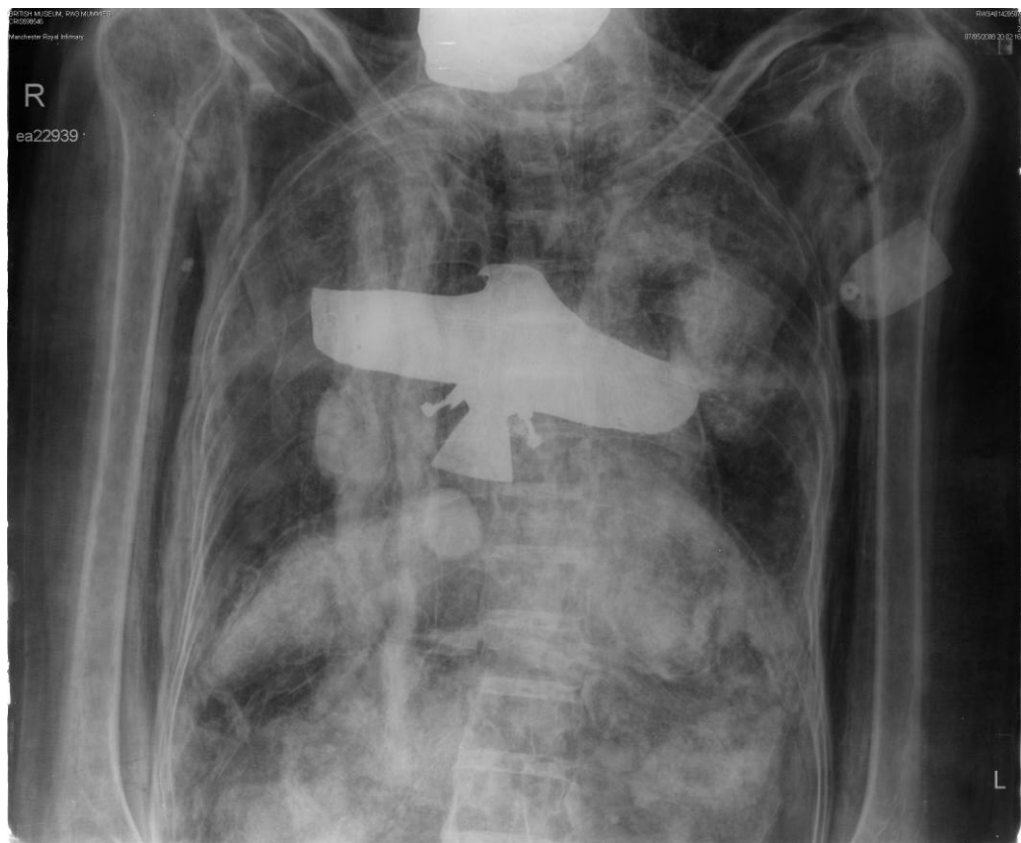
Cartonnage case of Tjentmutengebtu- EA 22939



Cartonnage case of Tjentmutengebtu- EA 22939



AP and LP X-ray radiographs of skull and neck of the mummy. The image shows the false eyes, the open mouth and the winged solar amulet on the neck. The cranial cavity appears to be empty.



AP X-ray radiograph of the chest and abdomen. An amulet of a falcon with stretched wings is placed on the chest. A foreign object can be seen near the left upper arm.



AP X-ray image showing the feet which are superimposed by a large solar winged scarab amulet.



AP X-ray image of the abdomen showing the position of the arms, the metal plate that covers the left side incision used to extract the internal organs, a cylindrical shaped amulet near the second lumbar vertebra and an amulet near the sacrum. A winged amulet can be seen over the pubic area.



The cartonnage and mummy during CT scanning



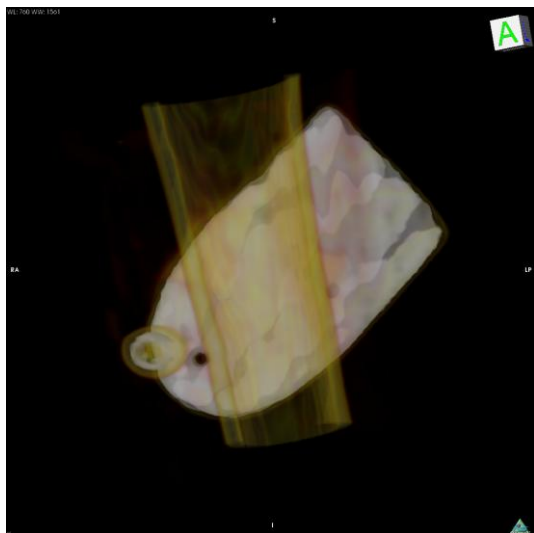
AP and LP scout images of the mummy and cartonnage case of Tjentmutengebtiu- EA 22939.



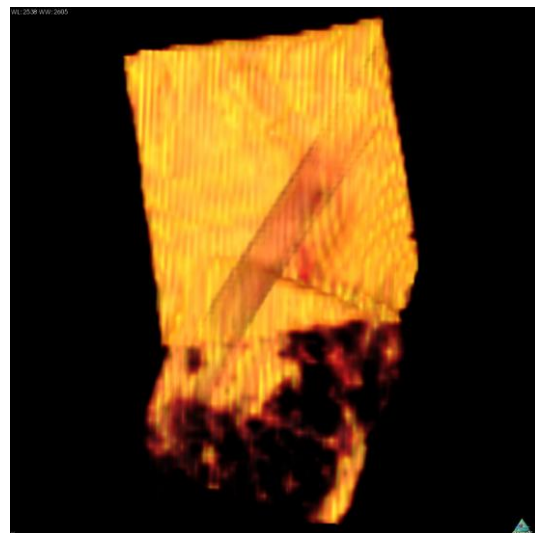
3D image of the mummy and cartonnage case showing the location of the amulets on the neck and the chest. The false eyes can also be seen.



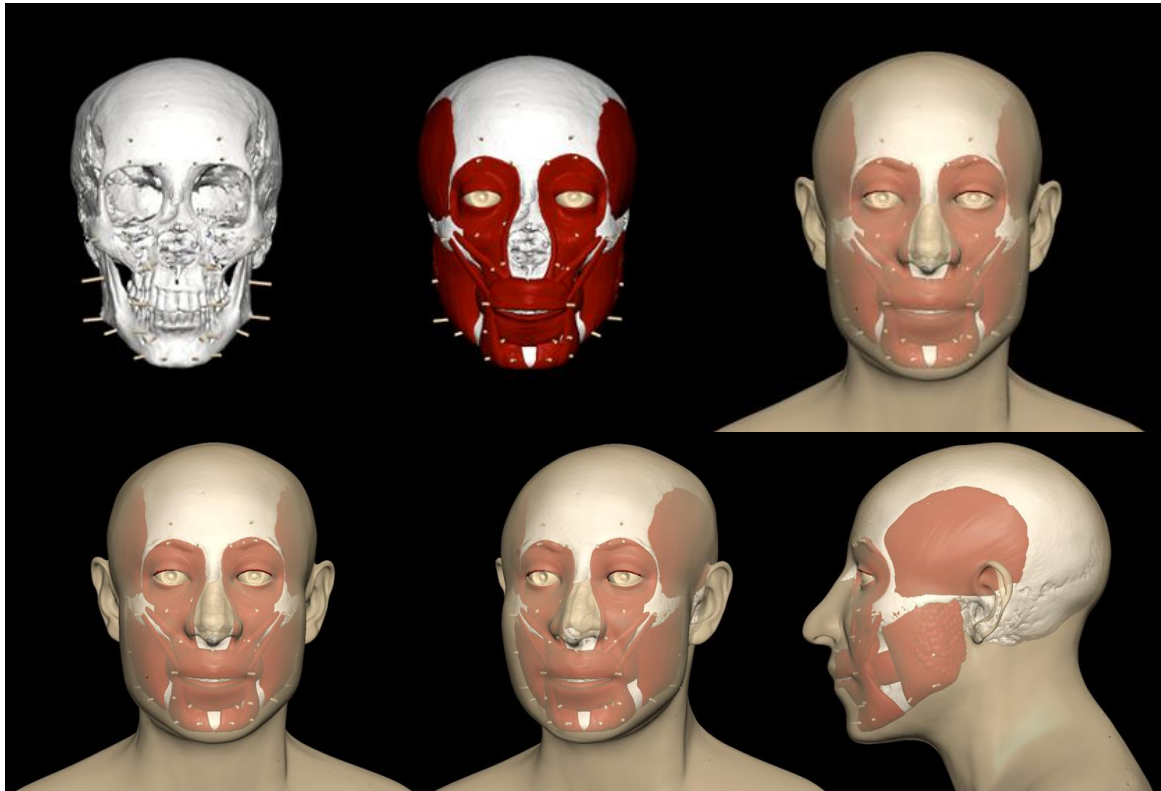
3D image showing the hands of the mummy resting on the upper thighs and the metallic amulet placed on the pubic area.



3D image of the metallic object observed under the upper left arm. It consists of two pieces, an upright bead-like piece and a flat sheet with rounded and pierced side.



3D image of the metal rectangular plaques that were placed by the embalmers over the side incision. This mummy has two overlapped plaques which is an unusual feature.



(left to right) The skull reconstructed from the CT axial images with the pegs to indicate thickness of soft tissue. The muscles were attached to the skull and a layer of skin was applied to show how Tjentmutengebtui looked during life.



The face of Tjentmutengebtui as reconstructed from her skull.

Cat. No. 6:Mummy inside cartonnage case of a Priestess:

Museum Inventory Number:EA 25258

Acquisition:Purchased from the auction house and dealers, Rollin & Feuardent, in 1894.

Associated objects:None

Provenance:Thebes

Date:22nd Dynasty

Dimensions:

- Cartonnage case:Length:165.4 cm (from AP scout), 165.9cm (from LP scout)
Width:49.5cm
- Mummy with wrappings:Length:156.7cm (from LP scout), 155.8 cm (from AP scout).
Width:36.4cm
- Mummy without wrappings:measurement could not be taken due to the disarticulation of the feet. The total height was measured by adding the distance from the head to distal tibial joint surface = 1432.5mm (so without fee), to the distance between the inferior surface of the calcaneus to upper surface of talar dome = 75.6mm (1432.5 + 75.6) which would produce a calculated height of approximately = 1508.1mm

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- Dawson, W.R. and Gray, P.H.K. (1968) *Catalogue of Egyptian Antiquities in the British Museum. I. Mummies and Human Remains*, 10, Pl:VIa, XXVIb. London.
- Gray, P.H.K. (1970) An Account of a Mummy in the County Museum and Art Gallery, Truro. *JEA* 56:134, n2.

Radiological analysis:

Conventional X-ray Radiography and multi detector CT scanning were used to examine the mummy on 8th May 2008. A total of 13 X-ray images were obtained (skull 4, thorax 2, pelvis and abdomen 2, limbs 5) and a total of 2709 slice images were produced during the CT examination. This is in addition to the AP and lateral projection scout views, the reformats and 3D images.

Physical anthropological data:

Sex:Female (the pelvis show typical female traits while the measurement of the femur head, 50 mm, indicates that it belongs to a male (Bass 1995:231)).

Age:40-50 years old

Stature:

Maximum length of right femur:40.7 cm
Maximum height:152.2 cm \pm 2.517 cm
Maximum length of left femur:41.31 cm
Maximum height:153.6 cm \pm 2.517 cm
Mean stature from femur:152.9 cm
Maximum length of right tibia:32.29 cm
Maximum height:148.23 cm
Maximum length of left tibia:32.92cm
Maximum height:149.9 cm
Mean height:149 cm

Exterior description:

The polychrome scenes were painted on a white background. The deceased is represented wearing a plain blue wig. The face is painted a light yellow colour usually used for females. A wide elaborate collar is depicted on the chest. A ram-headed winged Horus is represented on the chest. The usual *Htp di nsw* formula is inscribed on a long vertical line that extends from the abdomen to the foot area of the cartonnage. The wings of the protective deities depicted symmetrically on both sides, intersect and overlap each other and the inscription line but they do not obscure any part of the inscription. Some vertical columns usually used for inscriptions were left blank. Two symmetrical representations of Wepwawet as a jackal are depicted on both sides of the feet. The style of the cartonnage conforms to design 2B (Taylor 2003:105).

Radiological description:

Cartonnage case:Remains of the core can be seen in various locations on the internal surface of the cartonnage case. The face has a much higher density than the rest of the cartonnage due to plaster-like material that had either been applied to support the face during the manufacturing of the cartonnage or is the remains of the core that was intentionally left for the same reason. The face that has been fashioned in the anterior part of the cartonnage has an attenuation of 665HU. The upper part of the mummy occupies the right side of the cartonnage. There is a gap about 5 cm wide at the back of the cartonnage between the two sides of the slit used to insert the mummy into the cartonnage.

Wrappings:The thickness of the wrappings varies from one place to another, from just few millimetres at the back to more than 6 cm in the same CT axial slice. The wrappings are in good condition; loose fabric lies between the hands anterior to groin.

Skull and neck:The cranial cavity is empty and the ethmoids are damaged which indicates that the brain was removed through the nasal passage. The dorsum sella of the pituitary fossa is absent, also confirming this trans-ethmoidal, trans-sphenoidal approach of the brain removal. Artificial eyes (diameter = 28.7mm) are present in the orbital cavities. These have a low density centre (attenuation = - 508HU), and higher density rim surround (attenuation = 159HU) and a more dense lens (attenuation = 1307HU). The original eyes can be seen behind the artificial ones and the optic nerve is preserved.

There are several scattered bead-shaped metallic objects between the wrappings in a few areas of the body such as over the surface of the right false eye, hair and within the

wrappings. The largest of these bead-shaped round objects is about 6mm in diameter and has a high density (attenuation = 3071HU) suggesting gold. There is a fairly homogeneous dense pack (resin?) in the oropharynx (attenuation = 431HU; AP diameter = 35mm; coronal diameter = 60mm). It appears that resin was poured inside the mouth during mummification. The axial CT images show that the ears are preserved.

In the neck, there is a homogeneous anterior pack (attenuation = - 487HU; AP diameter = 26mm; coronal diameter = 55mm), which extends into the thoracic inlet where it becomes more heterogeneous (attenuation = - 465HU; AP diameter = 37mm; coronal diameter = 66mm).

Teeth:The mouth is slightly open. The teeth exhibit a high level of dental wear with no dental crowns preserved. There are no cysts to report from this individual. The upper right third and second molars are in occlusion. The second molar has very thin enamel due to wear. The first upper right molar is missing, probably pre-mortem. The upper incisors are present. The lower right third and second molars are present but show a high degree of wear. The lower right third molar is not in occlusion and was probably lost pre-mortem. The lower middle incisors are missing pre-mortem as evidence of remodelling of the bone at root level was observed from the CT images.

Spine and pelvis:Very good example of regular inter-vertebral space, with no evidence of spinal disease. There is a curvature of the spine which appears in the lumbar vertebrae but this could be post-mortem damage. The right side of the fifth lumbar vertebra measures 30.58mm while the left side measures 32.50 mm. There are remains of the spinal cord that can be seen in the reformatted images. The pelvis is ovoid, gynaecoid shaped which suggests a female skeleton. There is extensive, dense heterogeneous resin in the abdomen and pelvis. There are several packages in the pelvis. There is post mortem anterior subluxation of sacrum at sacro-iliac joints. Hips appear normal. Dense resin is pooled in the posterior pelvis. A number of small areas of metallic densities overlying left inferior pubic ramus which could be amulets or beads.

Thorax and abdomen:There are a number of packages in the thoracic cavity. There is dense amorphous heterogeneous resin in the apices and an anterior package extending posterior to sternum. There is linear tubular structure which could be portions of intestines. In the thorax, there is a structure which has a cavity which could be possible a heart.

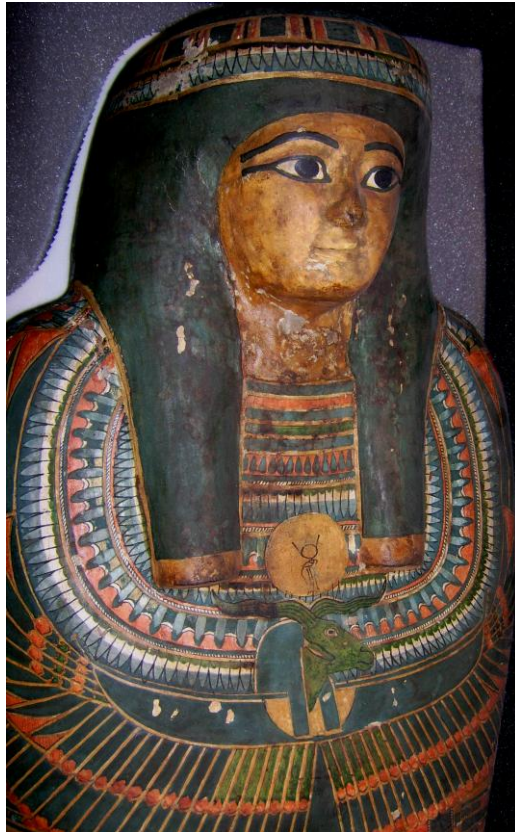
There is a defect in the left lower abdominal wall indicating the site through which abdominal contents were removed. In the perineum, there appear to be two orifices (vagina anteriorly and rectum posteriorly), suggesting the skeleton is that of a woman. The CT images show that an anal plug which was used to block the orifice as part of the mummification process.

Extremities:The arms are resting on the upper thighs. They were wrapped separately initially before being wrapped with the rest of the body. Every leg was wrapped separately first before they were they were included with the rest of the body. The soft tissue of the legs is well preserved and the structure of the tissue can be observed from the CT axial images. There are some metallic bead-shaped unidentified objects on the upper left thigh which appear to be on top of some packing material. The feet, as described by Dawson and Gray (1968), appear to be dislocated from the joint. There is no evidence of joint or bone disease or Harris growth arrest lines.

Comments:

The cartonnage has a face moulded out and supported by dense material. The skeleton is that of an adult female (ovoid gynaecoid pelvis) and is in good condition, except that the feet are detached at the ankles.

The brain has been removed through the trans-ethmoidal approach. False eyes are present. There is packing in the oropharynx and neck which extends into the thoracic inlet. Considerable amount of resin fills the thorax, abdomen and pelvis. The abdominal contents have been removed through the left anterior lower abdominal wall. There are some packages in the thorax and abdomen, in addition to some structures which may be components of intestines and organs. There is no evidence of significance bone or joint disease. There are unidentified bead-shaped metallic objects between the wrappings in a few areas of the body such as the head and the upper left leg. The soft tissue is well preserved especially in the area of the upper legs.



Cartonnage case and mummy of a priestess, EA 25258.



Cartonnage case and mummy of a priestess, EA 25258.



The X-ray examination of the upper part of the cartonnage.



The screen of the X-ray instant views showing an AP X-ray of the skull and upper chest of the mummy. Details of the face of the cartonnage can also be seen.



Lateral view of the skull and the cartonnage case showing the higher density of the facial area compared to the rest of the cartonnage case. It is also clear that the cranial cavity is empty.



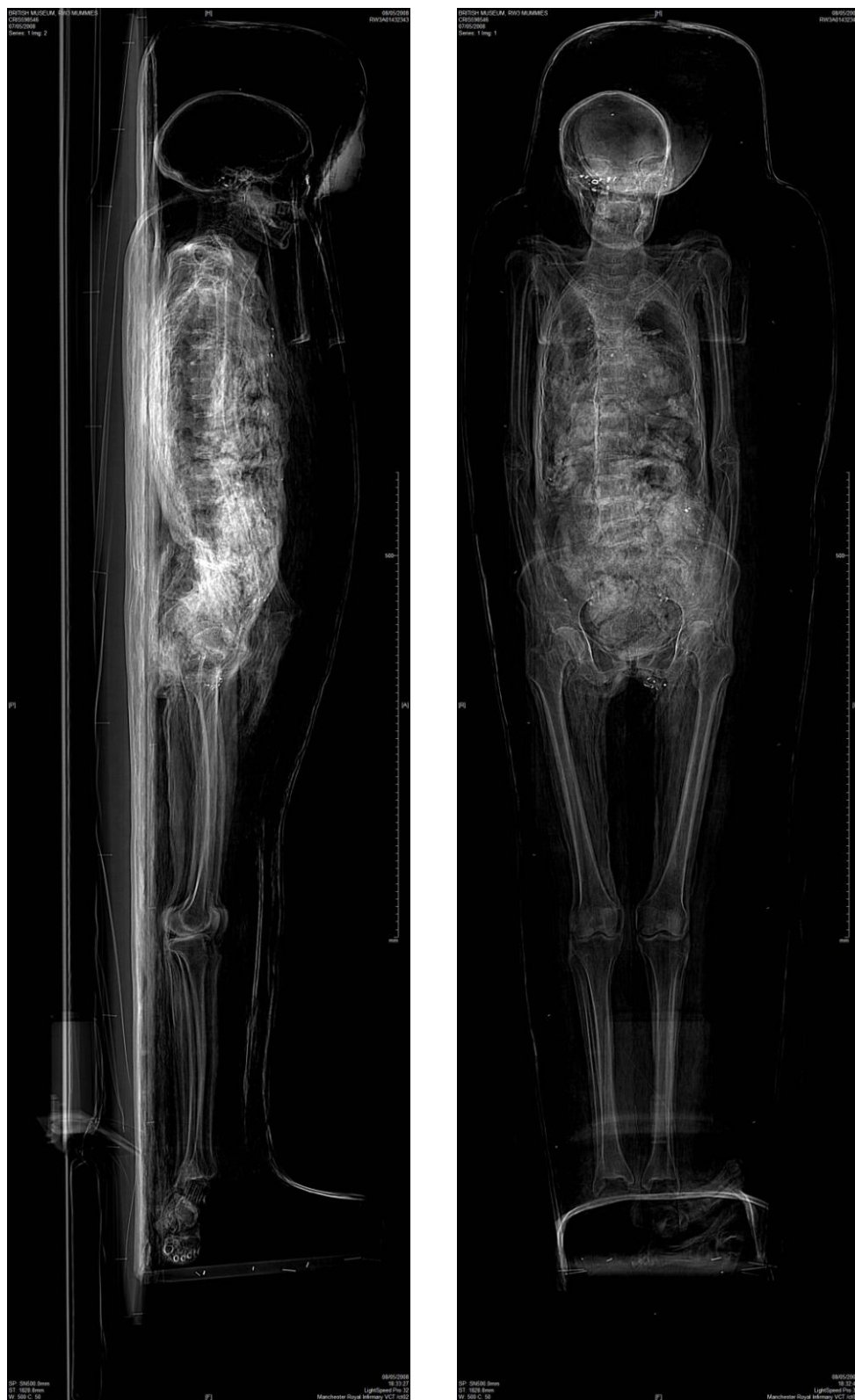
AP X-ray of the lower legs and feet area showing the unusual positioning and treatment of the feet.



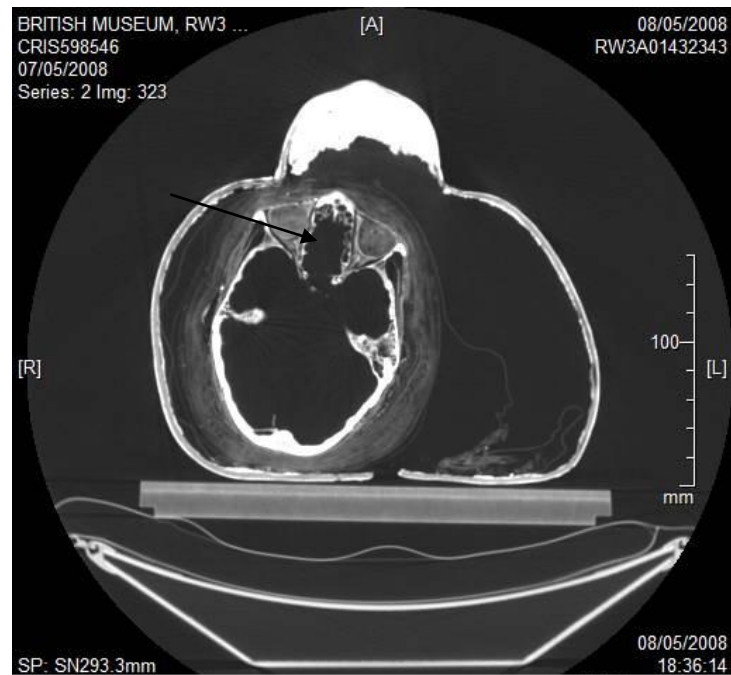
AP X-ray image of the abdominal area showing the location of the arms, the pelvis and the packages inside the abdominal cavity. The spine exhibits a noticeable curvature which could be postmortem.



The mummy during the CT examination.



AP and LP projection scout images of the full mummy and cartonnage



CT axial image showing the damaged ethmoids and the empty cranial cavity indicating that the embalmers took the nasal route for excerebration. The image also shows the dense material supporting the face of the cartonnage. The eyes are well preserved and the optic nerve can be seen on both sides.



A cross section at the abdominal cavity showing the side incision that was blocked by the embalmers during mummification.



Reformatted image showing the disarticulated unwrapped feet. One of the feet lay directly on the modern wooden replacement foot board. Both feet are not in line with the wrapped body and the damaged wrappings and the lack of attention shown by placing them in that manner might indicate that the damage to the feet was post mummification and post burial. If the mutilation was due to the embalmers, done for ritual reasons, the feet would have had the same attention as the rest of the body.

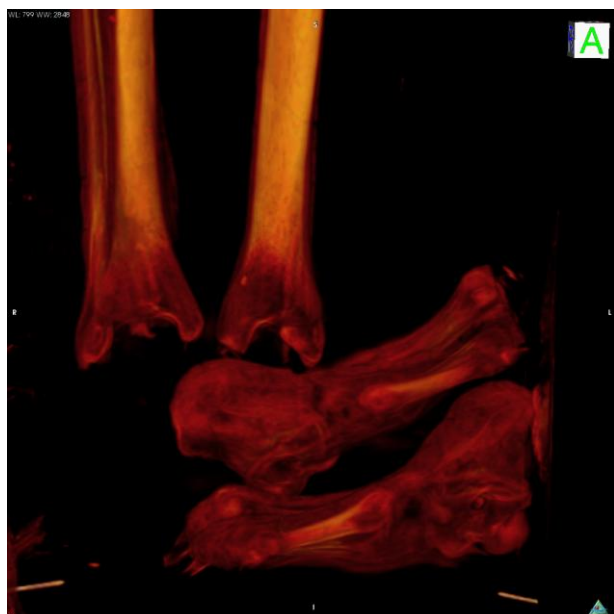


Reformatted image showing the empty cranium, the solidified dense resin in the mouth, the neck package which extends to the thorax, and the viscera packages inside the thoracic cavity. The image also show the skin fold at the back which might indicate that the lady was overweight.

3D image showing the relation between the cartonnage and the mummy and the high density of the facial area of the cartonnage.



3D image of the lower legs showing the feet that were separated from the body by the embalmers who included them with the wrapped mummy; an unusual treatment of the feet. The soft tissue of the feet is preserved and the bones are articulated.



Cat. No. 7:Mummy inside cartonnage case of Djedameniufankh:

Museum Inventory Number:EA 29577

Acquisition:The coffin and the mummy were purchased through Budge 1897 from the Giza Museum.

Associated objects:Coffin (EA 29577)

Provenance:unrecorded but probably Thebes (based on the style of the cartonnage)

Date:22nd Dynasty (based on the style of the cartonnage)

Dimensions:

- Cartonnage case:181cm (from BM online database)
- Mummy without wrappings:measurement cannot be taken due to the disarticulation of the skeleton.

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- The British Museum (1924) *Guide to the First, Second and Third Egyptian Rooms*. London:121-122 (the name and numbers are incorrect).
- Taylor, J.H. (2009b) Coffins as Evidence for a 'North-South divide' in the 22nd-25th Dynasties. In G.P.F. Broekman, R.J. Demarée and O.E. Kaper (eds.) *The Libyan Period in Egypt, Historical and Cultural Studies into the 21st– 24th Dynasties:Proceedings of a Conference at Leiden University, 25-27 October 2007*:375-415. Leiden:Peeters Leuven:385,393, 395, Pl:XI.
- Dawson, W.R., Gray, P.H.K. (1968) *Catalogue of Egyptian antiquities in the British Museum. I. mummies and human remains*, London:12,Pl:Vic, XXVIIa.

Radiological analysis:Conventional X-ray Radiography and multi detector CT scanning were used to examine the mummy on 8th May 2008. A total of 17 X-ray images were obtained (skull 3, thorax 3, pelvis 3, legs 6 and feet 2) and a total of 2443 slice images were produced during the CT examination. This is in addition to the AP and lateral projection scout views, the reformats and 3D images.

Physical anthropological data:

Sex:Male (confirmed by the size of the mastoid process)

Age:Between 15-25 years old (based on the teeth). The occipital lamboid sutures appear to have minimal closure and do not show large degree of fusion indicating a young adult. Most of the long bones are fully fused:for example, the humerus head (distal) which would fuse any time between the age of 15 and 22 years old. The age at death was probably around 20 years old, based on the fusion of the femur.

Stature: Femoral length = 46.35cm
Stature: 168.54 cm \pm 3.218cm
Tibial length = 37.82cm.
Stature: 165.80cm \pm 3.002cm

Exterior description: Djedamenuifankh is represented on the case wearing a light and dark blue stripy wig and a polychrome wide collar that covers the shoulders. Varnish was applied to alternative layers of the collar (i.e. only to the layers that have red, blue and white squares) and the rest of the layers were left without varnish. The scenes represented on the cartonnage are closely related to the Book of the Dead. The scenes were painted on a blue background which is an unusual feature. The outline of the figures was done in black ink on a white background before the artist painted all the background areas in blue, occasionally overlapping and obscuring the black ink in places. A final layer of varnish was then applied to the figures only, giving them a hint of a yellow colour which contrasts with the blue background. The face was also covered with a thick layer of varnish. Detail of the unguent cone is represented on the top of the head, and the back of the cartonnage has geometrical patterns representing a net bead (Taylor 2010:90). The front of the cartonnage is divided into eight compartments, each containing a different scene. The aim of these scenes is to guarantee that the deceased would pass safely into the underworld.

Radiological description: The skeleton is in poor condition due to post-mortem disruption which resulted in disarticulation.

Cartonnage case: The face of the cartonnage is made of wood through which there is an oblique crack in the centre. Within the wood there are two high density oblong structures which have an attenuation of 1306 HU suggesting a metallic substance. The larger one on the right of midline measures 29mm in sagittal diameter and 11mm in coronal diameter. The smaller area measures 15mm in sagittal diameter and 7mm in coronal diameter.

Wrappings: The wrappings are intact around the calves, providing evidence that the legs were initially wrapped separately and then wrapped together.

Skull: The skull is detached from the body and is located inside the head component of cartonnage, upside down with the occiput orientated to the left and the face orientated to the right. A bone defect in the ethmoid air cells indicates brain removal through this access site. There is widening of the diploic space of the skull vault indicating marrow hyperplasia, and suggesting that the mummy might have had anaemia or a haemolytic anaemia. Resin is layered both in the occipital region and the left side of the inner skull vault, suggesting mummification may have been in the supine and left lateral position.

Teeth: The upper teeth are present and the mandible is in the thoracic cavity. The upper teeth appear in good condition. There is no evidence of abscess or caries.

It is clear from the X-ray radiographs that the first upper right incisor is in occlusion but is chipped on the medial occlusion edge which is probably post-mortem damage. The enamel thickness of the anterior dentations was hard to assess based only on X-ray images. The second upper right incisor is missing, probably pre-mortem. The canine is in occlusion as well as the first and second molars and the premolar. The crown of the left upper incisor is missing, post-mortem. The second incisor is in occlusion and its crown is intact. The upper left canine is missing. The first and second molars are present but the third upper left molar is missing, probably post-mortem. The first, second and third molar at the right side of the

mandible all appear to be present. The first and second premolars are in occlusion as well as the canine. In the left side of the mandible, the first molar is present but loose with some dense enamel. The second molar is also present but loose. The third molar is present and its enamel is preserved. There is no evidence of abscesses or caries in the mandibular teeth. There is a possible bone loss at the lower right side between the first and second molars which could indicate periodontal disease. A loose third molar was detected next to the left femur.

Spine and Pelvis: A jumble of bones around the pelvis. There is dense material/disrupted package in the left side of pelvis. All joints in the pelvis show post-mortem dislocation. There is a triangular support, similar to that on the right, evident behind the left ischium.

Thorax and abdomen: The thoracic cavity contains a jumble of detached ribs and other bones. There is a segment of two vertebrae evident in the sagittal plane on the left. In these, the vertical trabeculae appear prominent, giving a striated appearance which may suggest osteopenia through loss of horizontal trabeculae. At this level on the left there is a triangular structure which continues to the foot and is obviously a support. It has a central lower attenuation centre (-600 HU) and a higher density rim (483 HU) and measures 27mm in sagittal diameter and 17mm in coronal diameter. It may be a reed or, more likely, a papyrus stem, based on the triangular shape of its cross section.

The abdominal cavity contains a complete jumble of various bones. There is a segment of 3 cervical vertebrae evident on the left side. There is only a few free floating layers of wrappings evident antero-laterally on the right side of the abdominal cavity.

Extremities: The left leg is internally rotated 90°. Some of the bones of the toes are detached. The right clavicle is next to the left knee. The right hand is pronated anteriorly over the right ilium suggesting the arms were pronated with the elbow extended and the hands overlying the thighs at the time of mummification. In the thighs, the bilateral supporting structure is evident posterior to the femora, and there are a few layers of disrupted wrappings. There is what appears to be a fabric package between the thighs, with a dense clump of resin adjacent to the left thigh. The supports are still visible posteriorly. At the knees, there is no evidence of joint disease and the supports can be seen adjacent and posterior to the lateral femoral condyle on the right, and medial femoral condyle on the left. There are several Harris growth arrest lines in the proximal and distal shafts of the tibiae, indicating episodes of illness or other causes of transient cessation of enchondral ossification of the growing skeleton. In the feet there is disarticulation of several phalanges.

Comments: The skeleton is that of an adult in a poor state of preservation, with extensive post-mortem disruption. There is evidence that the brain was removed through the transethmoidal approach. There is no evidence of joint disease but a suggestion of osteopenia with prominent vertical trabeculae in the vertebral bodies. There are Harris growth arrest lines visible in the tibiae. There are two supporting struts (papyrus stems?) evident which extend from torso to feet: the one on the right is longer than that on the left. Widening of the diploic space of the skull vault raises the possibility of haemolytic anaemia or anaemia with marrow hyperplasia.



The mummy and cartonnage case of Djedamenufankh



The mummy during the X-ray radiographic examination.



LP X-ray image showing the dislocated skull which has lost all its wrapping. The mandible which is missing here was found in the abdominal area of the cartonnage case.



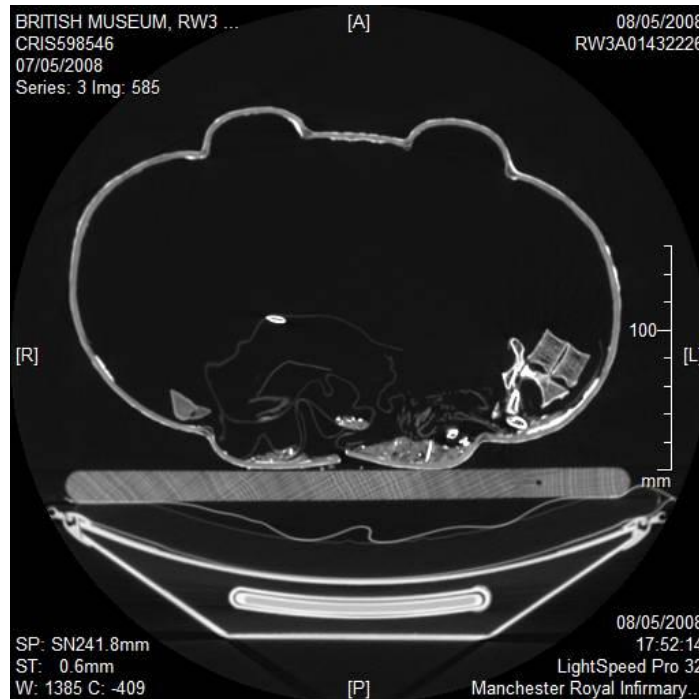
AP X-ray image of the lower legs and feet showing Harris line at the distal part of the tibia.



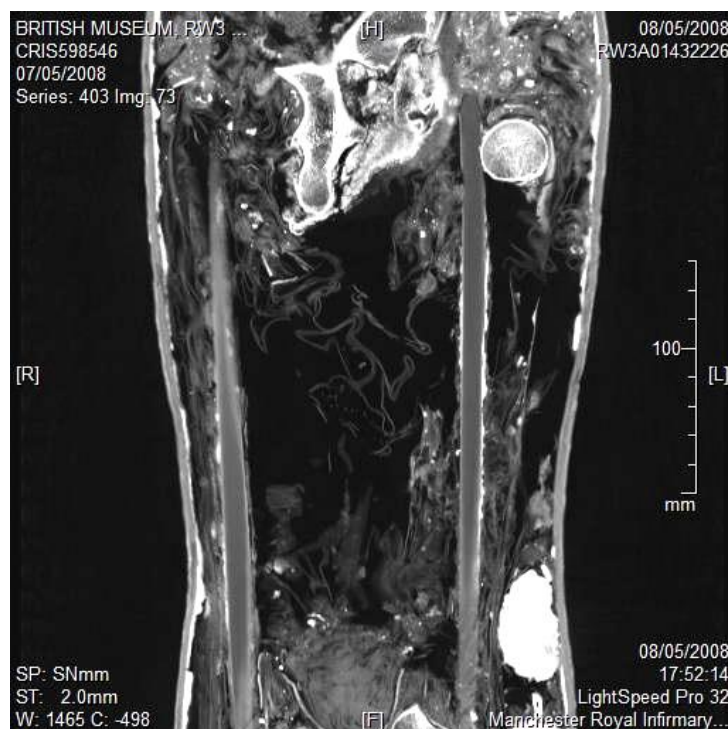
AP X-ray radiograph of the abdomen showing the mandible and the disarticulated ribs and long bones.



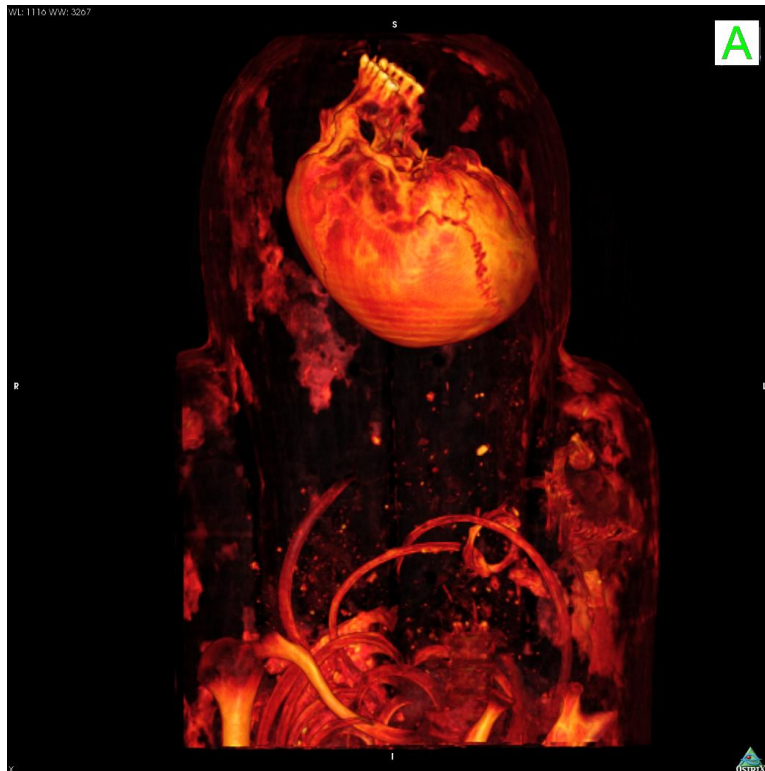
The mummy during the CT examination



CT axial image at the thoracic area of the cartonnage case showing the two articulated vertebrae with prominent vertical trabeculae which may suggest osteopenia through loss of horizontal trabeculae.



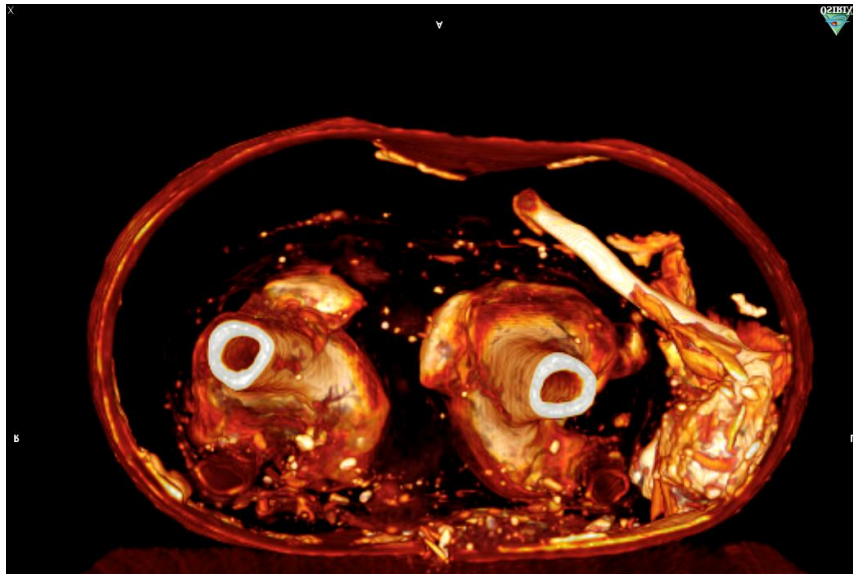
CT formatted image showing the two extended poles, probably papyrus stems, based on the triangular cross section, used by the embalmers to support the body of the mummy.



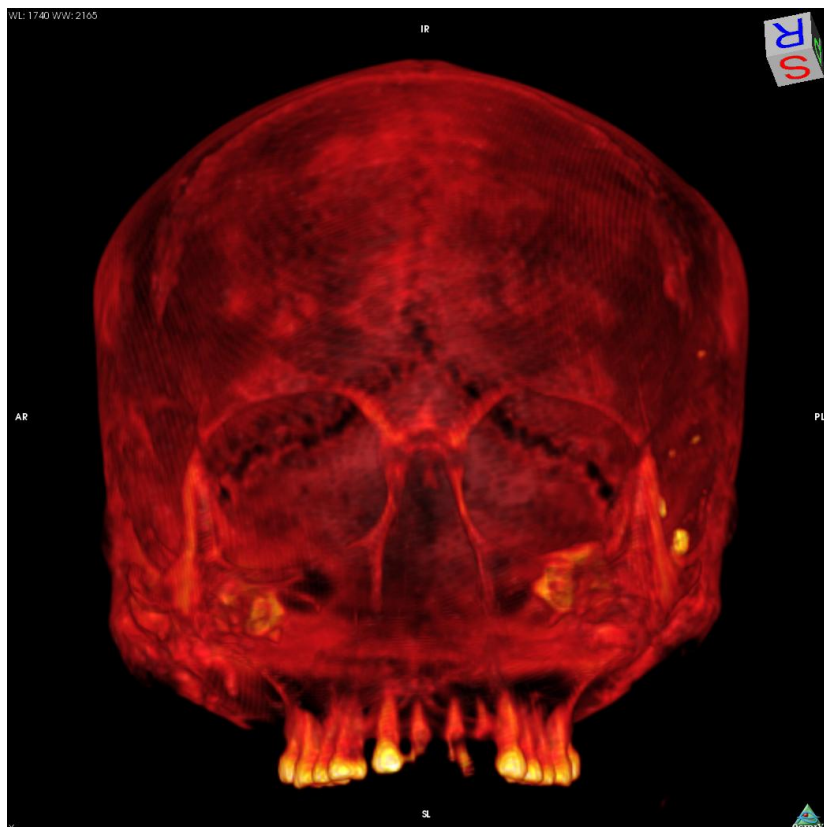
3D Image showing the disarticulated skull and its location within the cartonnage case. The state of disruption and disarticulation of most of the bones can be seen as well. Little soft tissue is preserved except around the long bones of the legs.



3D image of the abdominal area showing the state of disarticulation, the location of the hands and the twisted left femur.



3D image showing the twisted left leg and the disarticulated bones inside the cartonnage case. There is also a dense package, probably linen saturated with resin, next to the left leg.



3D image of the skull showing the teeth and the cranial sutures.